I/S: A JOURNAL OF LAW AND POLICY FOR THE INFORMATION SOCIETY

Ubiquitous Computing, Virtual Worlds, and the Displacement of Property Rights

M. SCOTT BOONE*

Abstract: Examining one emerging technology, virtual worlds, may provide us with insight about another emerging technology, ubiquitous computing. The rapid increase in both the popularity and economic value of virtual worlds has resulted in a conflict over whether players in these worlds have any property rights with respect to virtual world objects associated with their avatars. A close examination however reveals that even if such rights exist, they can be overridden through the combined use of contract and technology. This observation may in turn provide an insight about the future of real world property. The emerging technology of ubiquitous computing shares technological characteristics with virtual worlds such that ubiquitous computing would make a displacement of property rights in real world objects possible in the same way that virtual world technology makes such a displacement possible for potential property rights in virtual world objects.

* Associate Professor of Law, Appalachian School of Law. I would like to thank Charlie Condon, Judie Barger, David Ritchie and James McGrath for their helpful comments on drafts of this article. I would also like to thank for their comments the participants of the Works-in-Progress Intellectual Property Colloquium, the participants of the Intellectual Property & Communications Law and Policy Scholars Roundtable sponsored by Michigan State University College of Law, and the participants of the annual meeting of Southeastern Association of Laws Schools. The research assistance of Russell Kloosterman and Justin Williams was also immensely helpful.

> "It is coming because there are too many too powerful institutions vested in its coming, knowing what enormous market possibilities are opened up by the conquest of the everyday. It is coming because it is an irresistible, 'technically sweet' challenge, for designers no less than engineers. It is coming because something like it effectively became inevitable the moment our tools, products and services started communicating in ones and zeroes."[1]

I. INTRODUCTION

"It" is ubiquitous computing.[2] But what is ubiquitous computing? Hailed as the third paradigm of computing,[3] ubiquitous computing has been described as "the colonization of everyday life"[4] by computers and information technology. With its vision of applying computing ability and information technology to everyday life, ubiquitous computing promises to impact our lives to such a dramatic extent as to make personal computers and the Internet look like a primitive pilot program. Such a dramatic impact will undoubtedly have legal consequences–some easy to anticipate, others not. The primary purpose of this article is to propose that one legal consequence of the rise of ubiquitous computing may be the displacement of property rights as a rights ordering system.

This article does so both by a direct examination of the potential of ubiquitous computing technology and by examining another emerging technology: virtual worlds. With respect to the latter, this article first proposes that massively populated virtual worlds can serve as emulators of ubiquitous computing environments. Second, it argues

---

[1] ADAM GREENFIELD, EVERYWARE: THE DAWNING AGE OF UBIQUITOUS COMPUTING 3–4 (2006).

[2] The set of technologies and practices referred to here as ubiquitous computing has many names including pervasive computing, everyware, physical computing, and the Internet of things. For a more detailed explanation of the terminology, *see* Part II.A. *infra* notes 30–55.

[3] Mark Weiser & John Seely Brown, *The Coming Age of Calm Technology*, XeroxPARC, Oct. 5, 1996, http://www.ubiq.com/hypertext/weiser/acmfuture2endnote.htm; Ubiquitous Computing, http://www.ubiq.com/hypertext/weiser/UbiHome.html (citing Alan Kay of Apple as calling this next phase of computer development the "Third Paradigm" of computing). These paradigms have also been called "waves" and "phases." *Id.*

[4] GREENFIELD, *supra* note 1, at 33.

that, as predicted by virtual worlds, ubiquitous computing will enable interference with the exercise of personal property rights and will thereby enable displacement of property rights as an ordering system.

As the third paradigm of computing, ubiquitous computing completes the shift of the computer's place and role from its mainframe roots to its embedded future. The first paradigm of computing consisted of the mainframe computer filling entire rooms, utilized only by specialists.[5] The second paradigm of computing is the world of computing we currently experience, the world of personal computers.[6] At present, computing power has left the hands of specialists but remains almost entirely confined in isolated boxes of limited connectivity. In the third paradigm of computing, the paradigm of ubiquitous computing, the computer leaves its isolated box and its limited connectivity. The computer becomes embedded throughout the physical world receding into the background and becomes expansive, if not universal, in its connectivity.[7] The power of computing ability is utilized without recourse to an isolated box and is utilized in myriads of everyday tasks, not just in the limited number of tasks and applications available in the world of personal computers.[8] Computing ability is applied not only to functions such as word processing, information retrieval and electronic communication, but also to everyday tasks such as driving, and now to completely novel areas such as personal medical monitoring.

Descriptions of ubiquitous computing leave us with visions of such dramatic changes to our everyday world that it could be called revolutionary. Changes of this magnitude will undoubtedly create a plethora of legal issues, both by challenging the ability of existing legal rules to cope with radically new circumstances and by creating situations so new as to be seemingly ungoverned by existing legal rules.[9]

---

[5] Weiser & Brown, *supra* note 3.

[6] *Id.*

[7] *Id.*

[8] For a more detailed description and discussion of ubiquitous computing, *see* Part II, *infra* notes 25–71.

[9] These two classifications of new legal issues could also be rightly seen as two ends of a single spectrum. As the degree and amount of change increases, issues move from merely challenging the adequacy of existing rules to deal with new situations to being so different as to make existing rules seem no longer relevant.

Two legal issues presented by the advent of ubiquitous computing are readily apparent. The first is the potential loss of privacy in continuously monitored environments that constantly acquire, store and transmit information about individuals in those environments.[10] The second issue is the loss of Fourth Amendment protections that naturally flow from a combination of the government and the initial loss of privacy.[11] Both of these issues are presented herein to demonstrate the potential legal impact of ubiquitous computing, but neither is the main focus of this article.[12] Beyond these two initial issues, other legal issues created by ubiquitous computing are not readily apparent. The capabilities of a ubiquitious computing environment may suggest at least one additional issue.

Specifically, the capability of remotely monitoring and controlling physical objects provided by ubiquitous computing may make possible the interference with, and redistribution of, personal property rights. Ubiquitous computing could thereby displace property rights as a system of ordering rights. This would present such a drastic change, if it came to pass, that it may behoove us to ask a variety of questions to determine whether such a change would be desirable. For example, we may need to consider whether traditional property rights have some social benefit such that we may not want some combination of contract and technology to override them, or whether the greater potential for private ordering of individual preferences outweighs any possible negative consequences.[13]

---

[10] *See infra* notes 101–120.

[11] *See infra* notes 121–133.

[12] Both have been discussed in more detail elsewhere. *See, e.g.*, Susan W. Brenner, *The Fourth Amendment in an Era of Ubiquitous Technology*, 75 MISS. L.J. 1 (Fall 2005) (for Fourth Amendment); Jerry Kang & Dana Cuff, *Pervasive Computing: Embedding the Public Sphere*, 62 WASH. & LEE L. REV. 93 (2004) (for privacy); A. Michael Froomkin, *The Death of Privacy?*, 52 STAN. L. REV. 1461 (2000) (for privacy); Lars S. Smith, *RFID and Other Embedded Technologies: Who Owns the Data?*, 22 SANTA CLARA COMP. & HIGH TECH. L.J. 695 (2006) (for privacy impacts of RFID use); *see also* Kevin Werbach, *Sensors and Sensibilities*, 28 CARDOZO L. REV. 2321 (2007) (for a discussion of other potential legal impacts of increased sensor abilities and coverage).

[13] It is not the goal of this article to answer the question of whether the potential displacement of property rights in ubiquitous computing environments is a positive or negative development. Rather, the purpose of this article is to demonstrate that potential and to identify the questions and issues that need to be addressed to evaluate any positive or negative effects.

One of the most "ubiquitous" of current computing devices, the cellular telephone,[14] and the characteristics of the services associated with it, may have provided us with an example of this possible property issue, even if it has done so unwittingly and in an unexpected manner.[15] A relatively recent television commercial for cellular telephone service[16] sought to criticize the restrictions placed on the use of cellular telephones, a restriction made possible by the cellular telephone's "ubiquitous" characteristics, by placing those restrictions on an everyday physical object. The commercial featured a woman standing in a group of young children on a playground. Each child holds a red rubber ball. The woman asks the children if they each have a ball. When they all nod yes, she tells them that she needs to know how many minutes each of them is going to use their ball each month. She warns them to be careful in choosing because if they guess too few, then they will have to pay overage charges and if they guess too many, then they will be wasteful. The children respond with disbelieving, bewildered looks.

The commercial attempted to place competitors' use-restrictive plans in a negative light by drawing on how unnatural that type of restriction would be in other contexts. The commercial sought to critique other cellular telephone service providers' practice of forcing users to select minute plans in advance by placing the same type of time-based use restriction on an everyday physical object. A playground ball is not typically thought of as something that comes with restrictions. Of course, everyday restrictions on behavior may apply to the use of playground balls. For example, one could not, without legal consequence, throw the ball from an overpass into

---

[14] Of currently existing devices, cellular telephones are perhaps the closest to being examples of ubiquitous computing. Fabien Giradin & Nicolas Nova, *Getting Real with Ubiquitous Computing: The Impact of Discrepancies on Collaboration*, 1 EMINDS: INT'L J. ON HUMAN-COMPUTER INTERACTION 60 (2006), *available at* http://www.hci.uniovi.es/Resources/eminds/Vol%20I,%20Issue%201,%202005/eMinds%20Issue%201%20(FS1).pdf (stating the cellular telephone is "the most ubiquitous device" and describing its shortcomings as a fully ubiquitous device). In Japan, the cellular telephone has become the focus of development of ubiquitous computing capabilities. GREENFIELD, *supra* note 1, at 168–69.

[15] The commercial also demonstrates how a competitive market may operate to lessen possible prevalence of restrictions on property rights.

[16] The cellular telephone service company was Sprint. The commercial advertised that company's service plan that allowed customers to pay for the number of minutes they used that month instead of forcing them to select a set number of minutes per month and then charging them overage fees if they used more minutes in any particular month.

highway traffic. Similarly, one could not, without legal consequence, unilaterally start a game of dodgeball with surgeons performing open heart surgery. However, restrictions specific to playground balls do not generally exist, restrictions on the use of particular individual balls are certainly not the norm, and any restrictions that do exist are generally imposed by the government, not by the producer of the ball or some other private party.

The use of a physical object has traditionally been viewed as an exercise of the personal property right to use and to the quiet enjoyment of property.[17] The ball is purchased and then used whenever and however the owner wants to use it; the producer of the ball does not maintain any interest in the ball, does not monitor its use, and does not exercise any control over how the purchaser uses it. The same can be said for the vast majority of objects subject to personal property rights. For example, the use of chairs, televisions and automobiles is not generally monitored or controlled by the object's producer after possession has passed to a purchaser.[18]

The advancing technology of ubiquitous computing may change that situation. By making remote monitoring and control of objects both possible and practical, technology may create the ability to interfere with actions that have traditionally been viewed as exercises of personal property rights. This ability to interfere with the exercise of traditional personal property rights could thereby enable a displacement of property rights. By creating a system whereby rights in a physical object can be determined and enforced through technology, ubiquitous computing may allow a privately ordered system of rights to displace the publicly ordered system of property rights.

Perhaps surprisingly, this conflict between a publicly ordered system of personal property rights and a privately ordered system of rights defined by technology and contract, and the questions of which system will be preferred over the other, may first arise not in a world full of embedded computers, but in a world embedded in a

---

[17] ROGER A. CUNNINGHAM, WILLIAM B. STOEBUCK & DALE A. WHITMAN, THE LAW OF PROPERTY 6 (2d ed., 1993).

[18] The very limited exception to these examples is the renting and leasing of automobiles. The same characteristics that make such arrangements practical and economically viable for automobiles in a non-ubiquitous computing environment make automobiles a type of property that will likely be an early target for monitoring and control in a ubiquitous computing environment, and, thus, an early target for increased interference with the exercise of personal property rights.

computer.[19] The conflict may first arise in virtual worlds, in the context of objects that are not physical at all, but rather in objects that are entirely virtual. To demonstrate the potential conflict and to frame this problem, I will also examine the treatment of property rights in objects that can be said not to exist at all: virtual world objects. Massively populated virtual worlds, such as the worlds of Norrath,[20] Britannia,[21] and Azeroth,[22] allow players to accumulate, use and control numerous objects in those virtual worlds. Players can accumulate virtual clothes, virtual swords, virtual horses and even virtual houses. The demand for these virtual world objects is so great that a market in the real world has developed in which players of these games are willing to pay real money for these virtual objects.[23] Disputes arising from this practice, both between players and between players and virtual world operators, have raised the question of whether personal property rights exist in these virtual world objects, as well as the question of who owns the property rights if they do in fact exist.

This debate over property rights in virtual world objects and, more importantly, the way in which those in control of virtual worlds deal with property rights in virtual world objects, provide a glimpse of the possible future problems facing property rights in real world objects. The information technology of virtual world systems allows for personal property rights in virtual world objects to be both easily reallocated by contract and controlled by a rights management

---

[19] In many ways, ubiquitous computing is viewed as the opposite of virtual reality. The earliest writings on ubiquitous computing recognized this fundamental difference. "Perhaps most diametrically opposed to our vision [of ubiquitous computing] is the notion of 'virtual reality,' which attempts to make a world inside the computer . . . . Virtual reality focuses an enormous apparatus on simulating the world rather than on invisibly enhancing the one that already exists. Indeed, the opposition between the notion of virtual reality and ubiquitous, invisible computing is so strong that some of us use the term 'embodied virtuality' to refer to the process of drawing computers out of their electronic shells." Mark Weiser, *The Computer for the 21st Century*, SCI. AM., Sept. 1991, at 94–104.

[20] Norrath is the virtual world of the Massively Multiplayer Online Role Playing Game ("MMORPG") Everquest and Everquest 2. Wikipedia, Everquest, http://en.wikipedia.org/wiki/Everquest (last visited Apr. 1, 2008).

[21] Britannia is the virtual world of the MMORPG Ultima Online. Wikipedia, Britannia, http://en.wikipedia.org/wiki/Britannia (last visited Apr. 1, 2008).

[22] Azeroth is the main virtual world of the MMORPG World of Warcraft. Wikipedia, Azeroth, http://en.wikipedia.org/wiki/Azeroth_(world) (last visited Apr. 1, 2008).

[23] *See infra* notes 88–91.

system. Information technology makes the reallocation and control possible on a massive scale through automated means. The application of information technology, of computing ability, to virtual world objects occurs as a matter of course because virtual world objects are creatures of computers; they exist only through and within computers. The characteristics that flow from this relationship between virtual world objects and computing ability mimic the characteristics of physical objects in ubiquitous computing environments. Examination of issues surrounding property rights in virtual world objects therefore informs the discussion of the impact of ubiquitous computing on personal property rights. It seems that the same interference, reallocation, and displacement of property rights currently possible with virtual world objects may apply to real world objects with the adoption of ubiquitous computing technologies.

The advance of ubiquitous computing technology may force us to examine personal property rights on a deeper level. We may have to ask whether many of the personal property rights traditionally enjoyed by the owner of an object are simply accidents stemming from the physical characteristics of that object, physical characteristics, which, have made it impossible or impractical for the producer to monitor the object and control its use after ownership and possession have passed from the producer to the user. We may have to ask whether the traditional personal property rights enjoyed by the owner of an object rather than being accidents, instead provide some benefit to society such that we may decide to override technology-enabled private ordering[24] in favor of property-based public ordering. In this article, I seek to demonstrate how ubiquitous computing may create the ability to interfere with the exercise of personal property rights and, thereby, create the ability to displace property as a rights ordering system. Further, I seek to identify questions that need to be answered and further avenues of inquiry that need to be examined in order to assess the creation and potential impact of such capabilities.

In Part II, I first describe the near-future set of technologies often called ubiquitous computing; second, I describe virtual worlds and virtual world objects; and third, I discuss the similarities that allow us to treat virtual worlds as emulators of ubiquitous computing environments. Next, Part III examines the potential legal issues arising from ubiquitous computing. First, I briefly look at two related legal issues that are implicated by ubiquitous computing, namely the

---

[24] Technology-enabled private ordering contemplates both direct technological control and contractual restrictions made possible and efficient by advancing ubiquitous computing technology.

potential loss of privacy and Fourth Amendment protections; and then, I hypothesize that ubiquitous computing may give rise to a third legal issue, the displacement of personal property rights. In addition to examining this hypothesis directly, I argue that the issues surrounding personal property rights in virtual world objects support the described effect of ubiquitous computing on personal property rights. In Part IV, I identify many of the questions that need to be answered in order to evaluate this potential effect on personal property rights. Finally, I conclude in Part V.

II. UBIQUITOUS COMPUTING AND VIRTUAL WORLDS

Ubiquitous computing and virtual worlds both involve the application of computing technology to environments, whether physical or virtual. Because the characteristics of both environments flow from their computer-mediated nature, virtual worlds can serve as useful sources of information about a future ubiquitous computing world.

A. UBIQUITOUS COMPUTING: WHEN COMPUTERS INVADE THE REAL WORLD

Ubiquitous computing, which is sometimes also called pervasive computing,[25] is "nothing less than the colonization of everyday life by information technology."[26] It conceives of computers leaving their boxes and becoming embedded throughout the physical world;[27] it conceives of computing no longer being a conscious, focused activity, but rather as an activity that fades into the background as a calm, invisible process.[28] This invasion of the real world by computing ability will allow the application of computing power to actions and interactions previously unenhanced by computing ability, and it will make possible entirely new types of actions and interactions.[29] After a

---

[25] Kang & Cuff, *supra* note 12, at 95. *See also* Part II.A.1. *infra* notes 30–55.

[26] GREENFIELD, *supra* note 1, at 33.

[27] *Id.* at 18–23; Weiser, *supra* note 3; *see also infra* notes 56–71.

[28] GREENFIELD, *supra* note 1, at 18–23; *see also infra* notes 56–71.

[29] GREENFIELD, *supra* note 1, at 18–23; *see also infra* notes 56–71. Such dramatic change will undoubtedly produce legal concerns. The two most readily apparent issues, the loss of privacy rights and Fourth Amendment protections, have already been the subjects of commentary in legal academic literature. A third possible issue, the displacement of

brief look at the terminology in this area of computing technology, the concept of ubiquitous computing will be more fully explored.

1. UBIQUITOUS COMPUTING TERMINOLOGY

The area of ubiquitous computing is still relatively new and still developing; because of this, the terminology is also still developing.[30] The terms "ubiquitous computing" and "pervasive computing" are both widely used in the technical literature to describe the same future technologies.[31] Some authors will use "pervasive" to describe a subset of technologies or a particular characteristic of the larger group of technologies referred to as "ubiquitous computing."[32] For example, Lyytinen and Yoo define "ubiquitous computing" as the convergence of two phenomena: mobile computing and pervasive computing.[33] In their lexicon, "pervasive" refers to a high level of embedded computing ability.[34] Other authors will do the exact opposite, using "ubiquitous" to describe a subset of "pervasive."[35] Others will use the terms interchangeably.

---

personal property rights, is proposed in this article. These issues will be explored in Part III, *infra* at notes 101–234.

[30] GREENFIELD, *supra* note 1, at 11–13. *See also* Bruce Sterling, *Viridian Note 00459: Emerging Technology 2006*, VIRIDIANDESIGN.ORG, http://www.viridiandesign.org/2006/03/viridian-note-00459-emerging.html (last visited Apr. 1, 2008).

[31] *See, e.g.*, M. Satyanarayanan, *A Catalyst for Mobile and Ubiquitous Computing*, 1 PERVASIVE COMPUTING 2–5 (2002). "In the mid 1990s, the term *pervasive computing* came to represent essentially the same vision that Weiser defined. More recently, researchers have proposed other visions, such as *proactive computing* and *autonomic computing*. This proliferation of terms can be quite confusing, especially since they are all speculations about the future . . . . This magazine will treat *ubiquitous computing* and *pervasive computing* as synonyms–they mean exactly the same thing and will be used interchangeably throughout the magazine." *Id.* at 3.

[32] Kalle Lyytinen & Youngjin Yoo, *Issues and Challenges in Ubiquitous Computing: Introduction*, 45 COMMC'NS OF THE ACM 64 (2002); *see also* MAX K. GOFF, NETWORK DISTRIBUTED COMPUTING, FITSCAPES AND FALLACIES 52 (2004) (acknowledging that "[m]any authors do not distinguish between 'pervasive' and 'ubiquitous' when it comes to computing visions" but arguing that pervasive computing lies along a teleological vector whose ultimate terminal is ubiquitous computing).

[33] Lyytinen & Yoo, *supra* note 32, at 64.

[34] *Id.*

[35] Kang & Cuff, *supra* note 12, at 95.

The field of physical computing also encompasses many of the aspects of future uses on computing[36] described below as aspects of ubiquitous computing. Other terms used to try to encompass this technology and its potential applications include the "internet of things"[37] and "everyware,"[38] as well as abbreviations-as-words such as "ubicomp" and "PerC."[39] The technical literature is replete with a host of terms attempting to describe aspects of ubiquitous computing– "tangible media,"[40] "wearable computing,"[41] "augmented reality,"[42] "locative media,"[43] "near-field communications,"[44] "body-area networking,"[45] "proactive computing,"[46] "autonomic computing,"[47] and even Weiser's original "embodied virtuality."[48] Entirely new

---

[36] *See* DAN O'SULLIVAN & TOM IGOE, PHYSICAL COMPUTING: SENSING AND CONTROLLING THE PHYSICAL WORLD WITH COMPUTERS, xvii–xxix (2004).

[37] Often credited to labs at the Massachusetts Institute of Technology. *See* Sean Dodson, *The Internet of Things*, GUARDIAN, Oct. 9, 2003, http://technology.guardian.co.uk/online/story/0,,1058506,00.html.

[38] GREENFIELD, *supra* note 1, at 17. While this does appear to be an attractive term in its ease of pronunciation and apparent high level of inclusiveness, the fact that it is a homonym (or pun) for "everywhere" makes it much less useful outside the written medium.

[39] Kang & Cuff, *supra* note 12, at 95. "Ubicomp" is simply a widely-used abbreviation for ubiquitous computing. "PerC" is an abbreviation of pervasive computing coined by Kang and Cuff. What they define as pervasive computing or PerC is essentially equivalent to what is often meant by the term ubiquitous computing. *Id.*

[40] Sterling, *supra* note 30 (quoting B&A Staff, *Hiding in Plain Sight: An Interview with Adam Greenfield*, BOXESANDARROWS, Feb. 27, 2006, *available at* http://www.boxesandarrows.com/view/hiding_in_plain_sight.

[41] *See, e.g.*, Daniel Wagner et al., *Towards Massively Multi-User Augmented Reality on Handheld Devices*, *in* PERVASIVE COMPUTING 208–19 (Springer ed., 2005).

[42] Sterling, *supra* note 30.

[43] *Id.*

[44] *Id.*

[45] GREENFIELD, *supra* note 1, at 2.

[46] Satyanarayanan, *supra* note 31, at 4.

[47] *Id.*

[48] Weiser, *supra* note 19.

words are even created by those seeking to describe the future. The term "spime" has been defined as an object that is trackable in space and time.[49] Similarly, a "blogject" is an object that blogs.[50] A "ThingLink" is a unique identifier for physical objects.[51] There are also a number of acronyms competing for recognition: "UFOs" (Ubiquitous Findable Objects), or "EKOs" (Evocative Knowledge Objects).[52] It is perhaps not surprising that where the emerging technology itself has not solidified the terminology is still being worked out.

Apparently, there is some contention relating to the proper terminology in this area of emerging technology.[53] While what little legal scholarship that has been produced in this area uses the term "pervasive computing,"[54] the term "ubiquitous computing" appears to be commonly used in the technical literature.[55] The choice to use the term "ubiquitous computing" in this article is based on the observation of its frequent use in technical literature and not on any judgment on which term, if any, is preferable, more appropriate, or more accurate.

---

[49] Sterling, *supra* note 30 ("Spimes are manufactured objects whose informational support is so overwhelmingly extensive and rich that they are regarded as material instantiations of an immaterial system. Spimes begin and end as data. They're virtual objects first and actual objects second.").

[50] *Id.*; Julian Bleeker, A Manifesto for Networked Objects—Cohabiting with Pigeons, Arphids and Aibos in the Internet of Things (unpublished manuscript, on file with Near Future Laboratory), http://itp.nyu.edu/~rcc273/spring2006/netobjects/WhyThingsMatter.pdf (last visited Apr. 1, 2008).

[51] Sterling, *supra* note 30.

[52] *Id.* (adding "Acronyms are the small-change of the tech world.")

[53] *Id.* Sterling relates an interview he conducted with Greenfield about his choice of the term "everyware:" "Each of the terms already in use—'ubicomp,' 'pervasive computing,' tangible media,' 'physical computing,' and so on—is contentious. They're associated with one or another viewpoint, institution, funding source, or dominant personality. I wanted people relatively new to these ideas to be able to have a rough container for them, so they could be discussed without anyone getting bogged down in internecine definitional struggles, like 'such-and-such a system has a tangible interface, but isn't really ubicomp.'" *Id.*

[54] *See, e.g.*, Kang & Cuff, *supra* note 12, at 94; Susan W. Brenner, *Law in an Era of Pervasive Technology*, 15 WIDENER L.J. 667, 668 (2006).

[55] *See, e.g.*, Lyytinen & Yoo, *supra* note 32, at 63; Anne Galloway, *Intimations of Everyday Life: Ubiquitous Computing and the City*, 18 CULTURAL STUD. 384 (2004).

2. UBIQUITOUS COMPUTING DESCRIBED

Ubiquitous computing has been described as an "internet of things."[56] That a technology as new as the Internet would be used in a metaphor to describe ubiquitous computing indicates that ubiquitous computing as a concept has not yet entered into general awareness. Rich Gold used other metaphors to describe it:

> Ubiquitous computing is a new metaphor in which computers are spread invisibly throughout the environment, embedded and hiding as it were, within the objects of our everyday life. Each of these computers can talk with any of the other computers much like chattering animals in a living jungle, sometimes exchanging detailed information, sometimes just noting who's around. The everyday objects themselves become a kind of ruse: a baby doll (or toy block) might look like a familiar remnant of childhood, but it is really only one of a thousand distributed nodes which control the functioning of the whole house. Likewise, the baby doll itself activates its own mechanisms, behaviors, and charms based partly on the comings and goings of its adopted (organic) family, and partly on digital discussions with other objects in the house.[57]

Gold's description packs a number of discrete aspects of ubiquitous computing into a small space. Perhaps the best way to describe ubiquitous computing is to describe aspects of it. In a ubiquitous computing paradigm, computing functionality is embedded and mobile in an environment of universal connectivity that produces a high level of automation.

Ubiquitous computing is conceived of as computing ability and computer use leaving metal boxes and becoming embedded throughout our physical environment.[58] As Mark Weiser stated in his seminal 1991 article, "Ubiquitous Computing enhances computer use

---

[56] *See* Dodson, *supra* note 37.

[57] Rich Gold, *This is Not a Pipe*, 36 COMMC'NS OF THE ACM 72, 72 (1993).

[58] GREENFIELD, *supra* note 1, at 18 ("Part of what the [ubiquitous computing] paradigm implies is that most of the functionality we now associate with these boxes on our desks, these slabs that warm our laps, will be dispersed into both the built environment and the wide variety of everyday objects we typically use there.").

by making computers available throughout the physical environment, while making them effectively invisible to the user."[59] The first half of Weiser's statement points out a characteristic of ubiquitous computing most often referred to as "embeddedness." This, for example, would make most of the functions available from an Internet-connected computer simply always available. Computing functions, such as information retrieval and information storage, become universally available in contrast to the pre-ubiquitous computing situation in which one must go to a computer and actively manipulate the computing device.

> We live in a complex world, filled with myriad objects, tools, toys, and people. Our lives are spent in diverse interaction with this environment. Yet, for the most part, our computing takes place sitting in front of, and staring at, a single glowing screen attached to an array of buttons and a mouse. Our different tasks are assigned to homogeneous overlapping windows. From the isolation of our workstations we try to interact with our surrounding environment, but the two worlds have little in common. How can we escape from the computer screen and bring these two worlds together?[60]

In order to move computing away from restricted workstations and into the larger environment, many envision computing as an activity fading into the background, becoming effectively invisible (a concept also referred to as calmness). In fact, as the second half of Weiser's statement quoted above indicates, invisibility of computing is one of the goals of embeddedness. Instead of computers being localized within prominently noticeable boxes, and instead of one consciously going to the box to use a computer, the computer and the use of computers would fade into the background. "[Weiser and Brown] suggested that ubiquitous computing would become 'so commonplace, so unremarkable' that we would forget its enormous impact, just as we have with writing and electricity, two other ubiquitous technologies."[61]

---

[59] Weiser, *supra* note 19.

[60] Pierre Wellner, Wendy Mackay & Rich Gold, *Computer-Augmented Environments: Back to the Real World*, 36 COMMC'NS OF THE ACM 24 (1993).

[61] Galloway, *supra* note 55, at 6 (quoting Weiser & Brown, *supra* note 3).

The second most often identified characteristic of ubiquitous computing is mobility. "Mobile computing is fundamentally about increasing our capability to physically move computing services with us. As a result, the computer becomes a taken-for-granted, ever-present device that expands our capabilities to inscribe, remember, communicate, and reason independently of the device's location."[62]

Mobility can take two forms. In the first form, computers become more and more mobile such that we take them with us wherever we might go. One has only to imagine the next step in the historical trend towards progressively smaller and more mobile computing devices, from room-sized mainframes, to desktop boxes, to laptops, to personal digital assistants and cellular telephones.[63] In the second form, mobility refers to always having access to computing ability and access to one's data through broadband-networked computers embedded throughout the physical environment.[64] With true computing mobility, one would always have access to computing capabilities as well as to one's own data.[65] In other words, with mobility, computing services "move with us."[66] "Thus, personal data, preferences and services [would] not exist redundantly any more on multiple devices with different settings, but [would be] available seamlessly to us anywhere and at any time."[67]

This mobile system will likely be capable of functioning autonomously as well as through conscious user control. A ubiquitous computing environment could automatically sense your presence and carry out certain functions, such as adjusting thermostat settings to meet your stored preferences, notifying certain parties of your present

---

[62] Lyytinen & Yoo, *supra* note 32, at 63–64.

[63] *Id.* at 64.

[64] *Id.*

[65] The idea that computing power and connectivity are available anywhere and at any time is sometimes also referred to as "ambient." *See* Laurent Ciarletta, *Emulating the Future with/of Pervasive Computing Research and Development*, *in* WHAT MAKES FOR GOOD APPLICATION-LED RESEARCH, WORKSHOP PERVASIVE 2005 (Munich Germany, May 2005), *available at* http://www.cl.cam.ac.uk/~gfc22/ubiappws/finalpapers/ubiappws-Ciarletta.pdf.

[66] Sarah Spiekermann & Frank Pallas, *Technology Paternalism–Wider Implications of Ubiquitous Computing*, 4 POIESIS & PRAXIS INT'L J. ETHICS OF SCIENCE AND TECH. ASSESSMENT 6 (2005), *available at* www.springerlink.com/link.asp?id=109376.

[67] *Id.*

location, re-routing communication attempts to your present location, or rescheduling appointments that the computer determines you will not be able to make based on your current location. On the far end of speculation, a room's sensor might even be able to read your emotional state by registering your heart rate, the furrow of your brow, and the number of times you blink your eyes and then comparing those values to your known norms. If sufficient changes and patterns are detected, the system could then automatically put you in touch with your therapist.[68]

The ability to detect location is another important aspect of ubiquitous computing environments. This locative ability applies not only to persons in the environment but to objects as well. Making objects recognizable, in other words making them computer readable, can be referred to as "virtualizing" the objects. Further, sensors allow embedded computers to track not only an object's location, but also other information regarding the object's status. This aspect of a ubiquitous computing world invites comparisons to William the Conqueror's Domesday Book:

> In December 1085, William the Conqueror commissioned the "Domesday Book," a massive project to record all of England's 13,418 settlements south of the rivers Ribble and Tees (the border with Scotland at the time). It was an exhaustive compilation, the greatest and most exact land survey that the world has ever known. The book included extensive records of landholders, tenants, natural resources, buildings, livestock, and practically all other tangible assets. At the time, an observer wrote, "There was no single hide nor yard of land, nor indeed one ox nor one cow nor one pig which was left out." The collection effort was finished by the summer of 1086.
>
> A valiant effort, to be true. But there was one problem: Despite the all-encamping nature of the book, or perhaps because of it, much of the information in the Domesday Book was out of date before the book was even finished. In fact, by the time William died in September of 1087, the project was abandoned.

---

[68] *See* Nancy Ectoff, *Brain Scans, Wearables, and Brief Encounters*, THE NEXT FIFTY YEARS: SCIENCE IN THE FIRST HALF OF THE TWENTY-FIRST CENTURY 277–89 (John Brockman ed., 2002).

> With modern technology, we can do better. Much better.
>
> For the first time in history, it may soon be possible to keep track of everything—every pencil, sweater, light bulb, car, and even every person—through tiny embedded computer chips hooked up to miniature antennas.[69]

Most conceptions of ubiquitous computing also include autonomously responsive intelligent environments, or as two commentators described them, "networks of miniaturized, wirelessly interconnected, sensing, processing, and actuating computing elements kneaded into the physical world."[70] The most common example is the "aware home" or "smart home." A "smart home" can acquire data on the occupant's status from something as simple as the occupant's location within the house to the occupant's current weight to monitoring bodily excretions for medical conditions. Based on the acquired data, the home might turn on certain lights while turning others off, might make suggestions regarding the occupant's diet, and might schedule a doctor's appointment for the occupant. A smart home might also regularly inventory the contents of the refrigerator and pantry, and then order items that have been depleted or that have expired.

Another potential example would be a "smart" car as described by Spiekermann and Pallas:

> This embedded 'intelligence' gives objects the capability to obtain information from the environment and utilize it to dynamically respond to detected outside conditions. An example for such responsive behaviour are sensor enhanced cars which register driving speed and match this information with roadside speed limit signs. Based on this matching operation the car then deducts (computes) autonomous actions (output). For example, it adjusts speed to traffic regulations. Such actions may be performed silently in the background and without any user interference (the driver of the car) or explicit user attention. The principle of silence

---

[69] Katherine Albrecht, *RFID: The Doomsday Scenario*, *in* RFID APPLICATIONS, SECURITY, AND PRIVACY 259 (Simson Garfinkel & Beth Rosenberg eds., 2006) (quoting in part The Domesday Book Online, *Frequently Asked Questions*, www.domesdaybook.co.uk/faqs.html (last visited Apr. 1, 2008)).

[70] Kang & Cuff, *supra* note 12, at 99.

> and autonomy is often referred to as the principle of "calmness."[71]

Objects of all types, from houses to cars to appliances, will be able to function in more automated manners, with less need for manual, real-time control.

Ubiquitous computing thus envisions computers that are embedded throughout the physical environment, that can communicate with each other, and that can monitor their surroundings and respond in dynamic, "intelligent" ways. Ubiquitous computing will allow the power of computing ability to be utilized beyond its traditional box and will allow the power of computing ability to be applied to almost every aspect of our lives.

B. VIRTUAL WORLDS: WHEN THE REAL WORLD INVADES COMPUTERS

While the world of ubiquitous computing may seem like a distant proposition, a different type of technology-produced world is already upon us: the virtual world. In describing the virtual world as a world embedded entirely within computers, the concept of a virtual world at first seems the polar opposite of a ubiquitous computing world. Yet, the two share an important common trait: both are mediated by computing ability. Virtual worlds may, therefore, provide us with important insight into a ubiquitous computing world, an argument taken up in more detail in Part II.C.[72]

Additionally, virtual worlds, unlike a ubiquitous computing world, are already populated and are capable of being observed presently. Thus, virtual worlds may be useful phenomena for us to examine in order to gain a better understanding of the possibilities presented by ubiquitous computing.

1. VIRTUAL WORLD TERMINOLOGY

What does "virtual" mean? One simple way to look at the meaning of "virtual" is to define it in relation to "real" and "imaginary." "Real" is that which is; "imaginary" is that which is not; and "virtual" is that which is not, but has the form or effect of that which is. "Virtual" may

---

[71] Spiekermann & Pallas, *supra* note 66, at 1.

[72] *See infra* notes 96–100 and accompanying text.

not be an ideal term to use. Because of its overuse in recent years to refer to anything and everything that is even tangentially connected to the Internet, much like the prefix "e-," "virtual" has lost much meaning by becoming indistinct. However, no better term has presented itself.

The term "world" in "virtual world" might be understood to refer to a persistent, shared intangible space or interface that seeks to mimic the appearance and behavior of the physical world. That would probably be an accurate description of what is most often referred to as a virtual world. However, "virtual world" can be used to describe something less than that; it can be used to describe any persistent, shared intangible space. Because of the desire to compare virtual worlds with a ubiquitous computing world, the term "virtual world" will be used to refer to those virtual worlds that seek to mimic the physical world.

The term "virtual world objects" is preferred over "virtual property," "virtual world property," and "virtual objects." "Objects" is preferred over "property" because use of the word "property" with either "virtual property" or "virtual world property" invites confusion about whether one is discussing property in the legal sense, a bundle of rights, or in the lay sense, the subject of those rights. It is acknowledged that the word "object" may carry with it certain definitional baggage, such as the unspoken assertion that the thing denoted has certain characteristics associated with "objects" generally.

However, any such definitional baggage is certainly no more, and likely much less, than that associated with the use of the term "property." "Virtual world" is preferred over "virtual" because "virtual objects" may include more than "virtual world objects." For example, e-mail accounts or songs that are sold by an online supplier such as iTunes and, thus, only exist as some combination of code, data, and database entries on one or more computers may be "virtual objects" but would not be "virtual world objects." The discussion of virtual property and virtual world objects is more fully covered in Part III.C.2. below.[73]

2. VIRTUAL WORLDS DESCRIBED

There is no single agreed upon definition of what a virtual world is. One online source defines "virtual world" as "a computer-based simulated environment intended for its users to inhabit and interact

---

[73] *See infra* notes 152–208 and accompanying text.

via avatars."[74] Avatars serve as the graphical representation of the player in the world, and it is through these avatars that players interact with the world and each other. In DESIGNING VIRTUAL WORLDS, Richard Bartle defines them by describing the characteristics of most virtual worlds:

> [They] are implemented by a computer (or network of computers) that simulates an environment. Some—but not all—the entities in this environment are under the direct control of individual people. Because several such people can affect the same environment simultaneously, the world is said to be *shared* or *multi-user*. The environment continues to exist and develop internally (at least to some degree) even when there are no people interacting with it; this means it is persistent.[75]

Most definitions of virtual world include a requirement that the environment be persistent; that is, the environment continues to exist even when a player is not present as an avatar.[76] Many definitions also include a requirement that the environment be dynamic, meaning that it changes over time.[77]

Virtual worlds have evolved from relatively sparsely populated text-based systems running in the spare space on a few university mainframes to immensely populated three-dimensional, graphics-based systems running on profitable commercial servers.[78] In most popular virtual worlds, the environment is represented by three-dimensional graphics of varying degrees of detail. An avatar whose behavior is controlled by a player represents that player in the virtual world; the avatar thus represents the player as a graphical presence in

---

[74] Wikipedia, Virtual World, http://en.wikipedia.org/wiki/Virtual_world (last visited Apr. 1, 2008).

[75] RICHARD A. BARTLE, DESIGNING VIRTUAL WORLDS 1 (New Riders Games ed., 2004), *available at* http://proquest.safaribooksonline.com/0131018167.

[76] *E.g.*, WordIQ.com, Virtual World, www.wordiq.com/definition/Virtual_world (last visited Apr. 1, 2008); Electronic Arts Inc., Ultima Online Visitor's Center: What is UO?, www.uo.com/ageofshadows/viscent.html (last visited Apr. 1, 2008); Sony Online Entertainment, EverQuest Index, eqlive.station.sony.com/library/faqs/faq_eqlive.jsp (last visited Mar. 28, 2008).

[77] *Id.*

[78] For a full description of the history of virtual worlds, *see* BARTLE, *supra* note 75, at 1–31.

the virtual world. In virtual worlds, large numbers of physically separate players operating Internet-connected computers can interact with each other in the virtual world through their respective avatars. While completely accurate numbers of participants in virtual worlds is difficult to ascertain,[79] estimates put the number of participants well over twelve million.[80] The largest virtual world, in terms of population, is currently that of World of Warcraft, with a subscriber base estimated at over 6.5 million subscribers.[81] Out of the more than 230 countries in the real world, that population would allow the virtual World of Warcraft to crack the top 100, just behind Hong Kong, just ahead of Paraguay, and in a dead heat with Tajikistan.[82]

The most successful incarnations of virtual worlds currently are the Massively Multiplayer Online Role Playing Games, ("MMORPGs") which are also sometimes referred to as game worlds or structured worlds. Some of the most popular U.S. MMORPGs are World of Warcraft, Everquest, Ultima Online, Dark Age of Camelot, Star Wars Galaxies, and City of Heroes.[83] The first four are fantasy theme settings. The last, City of Heroes, is set in modern times with a superhero theme. Star Wars Galaxies is, of course, set in the science fiction setting inspired by the Star Wars movie franchise.

Another type of popular virtual world is the social virtual world, also sometimes referred to as "unstructured." Some popular social virtual worlds are Second Life, Sims Online, Project Entropia, and There.[84] Categorization as "social" does not completely describe these virtual worlds. Each world is also premised to a lesser or greater

---

[79] The primary reasons for difficulty are the fact that a single individual might have multiple accounts in one or multiple virtual worlds and the fact that the numbers reported by the owners of each virtual world to count participants can be subject to artificial inflation.

[80] MMOGCHART.COM, www.mmogchart.com (last visited Apr. 1, 2008).

[81] *Id.*

[82] Wikipedia, List of Countries by Population, http://en.wikipedia.org/wiki/List_of_countries_by_population (last visited Apr. 1, 2008).

[83] Legend of Mir, Final Fantasy XI, Lineage II, MU Online, Ragnarok Online, Lineage, and Kingdom of the Winds are some popular Asian MMORPGs. Dubit, Runescape, Playdo, and Habbo Hotel are popular in Europe. *See generally* Terra Nova, terranova.blogs.com (last visited Apr. 1, 2008).

[84] For a broader list of social virtual worlds, *see also* Virtual Words Review, *Index*, http://www.virtualworldsreview.com/index.shtml (last visited Apr. 1, 2008).

extent on user-created content. For example, Second Life started as a largely blank slate with most in-world objects being designed and created in-world by individual players.[85] Social worlds can also have some game-like incentive aspects.

Avatars are generally subject to a large degree of customization. Within most MMORPGs, players can choose their avatars' race and gender as well as customizing their avatars' appearance within certain ranges.[86] Second Life allows the appearance of avatars to be altered along most variables, for example, height, skin color, weight, facial features, hair style and color.[87]

The abilities and appearance of each avatar can also be affected by the acquisition of virtual world objects. These objects can take many forms including currency, weapons, armor, and magic wands or castles in virtual worlds with a fantasy setting. In the Star Wars Galaxies world, the objects can take the form of currency, blasters, light sabers, droids or star fighters. In other possible worlds, the objects could take the form of a Nike t-shirt or Converse sneakers worn by the player's avatar. These objects can be acquired in a number of ways. They can be constructed, found, won, or purchased. In many virtual worlds, a player can specialize his avatar in crafting virtual world objects.

For example, a good way to earn virtual currency in Britannia, the virtual world of Ultima Online, is to become a blacksmith. The player directs his avatar to mine virtual ore in the hills of the virtual world, to transport the ore back to his forge, to smelt the ore, and then finally to forge a virtual sword. The player can then direct his avatar to sell the virtual sword to another player's avatar in exchange for virtual currency. Players can also purchase virtual world objects such as swords or blasters from trader bots, interactive computer-controlled parts of the environment that simulate a trader of goods within the virtual world.[88]

---

[85] Second Life, Create Anything, http://secondlife.com/whatis/create.php (last visited Apr. 1, 2008).

[86] This feature in City of Heroes led to some legal difficulties for the virtual world's corporate creators because it gave players the ability to create knock-offs of comic book superheroes, the rights to which were held by other corporations.

[87] Second Life, Create an Avatar, http://secondlife.com/whatis/avatar.php (last visited Apr. 1, 2008). There apparently are limitations. Some players have complained about not being able to create older looking avatars or disabled avatars.

[88] *See generally*, JULIAN DIBBELL, PLAY MONEY: OR, HOW I QUIT MY DAY JOB AND MADE MILLIONS TRADING VIRTUAL LOOT (Basic Books ed., 2006).

Virtual world objects can also be found within the virtual world environment if placed there by the world designers or dropped by another player's avatar. One of the most common ways to acquire virtual world objects within MMORPGs is to defeat an enemy, either a computer-controlled enemy or another player's avatar, where the enemy is either carrying or guarding the object—slay the virtual dragon and take his virtual treasure.

Virtual world objects play a large role in most virtual worlds. In virtual worlds that purport to be games, objects are both goals to be sought after and the means to accomplish further goals. Players devote effort and time to acquire virtual world objects, both because the objects can be desired in and of themselves and because the objects can be crucial in enabling the player to accomplish more difficult tasks within the game world. In social worlds, such as Second Life, virtual world objects have both functional and expressive roles. A virtual slot machine might allow a player to participate for his or her enjoyment[89] in a game of chance, or a virtual building might allow the display of artwork. In their expressive role, virtual world objects are used extensively to customize avatars and their environments. In some virtual worlds, the acquisition of virtual world objects for one's social space seems to be the main activity of players.[90]

Because of the high level of desirability of virtual world objects, markets for these objects have sprung up. While both game-sponsored and spontaneous markets for objects exist within the virtual worlds, markets have also grown up outside virtual worlds. These transactions, often referred to as real money transfers, see virtual world objects changing virtual hands for the exchange of real world currency. The levels of real money transfers have reached such a level that economists have been able to perform economic analysis on virtual worlds as if they were real world countries.[91] For example,

---

[89] Or for a chance at acquiring a specific type of additional virtual world objects–virtual currency.

[90] *See, e.g.*, Fred J. Aun, *Virtual Penguin World Now Part of Disney Magic*, E-COMMERCE TIMES, Aug. 2, 2007, *available at* http://www.technewsworld.com/story/gaming/58638.html.

[91] Edward Castronova, *Virtual Worlds: A First-Hand Account of Market and Society on the Cyberian Frontier*, 2 THE GRUTER INSTITUTE WORKING PAPERS ON LAW, ECONOMICS, AND EVOLUTIONARY BIOLOGY 1 (2001), *available at* http://cyber.law.harvard.edu/studygroup/castronova.pdf; *see also* Julian Dibbell, *The 79th Richest Country on Earth Doesn't Exist*, WIRED, Jan. 2003 at 106, 108 (discussing the extent of online markets for virtual world objects); *see generally* EDWARD CASTRONOVA, SYNTHETIC WORLDS: THE BUSINESS AND CULTURE OF ONLINE GAMES (University of Chicago Press ed., 2005); *see generally* DIBBELL, *supra* note 88.

several years ago, Edward Castronova estimated that, in light of the amount of time needed to acquire certain virtual world objects, the amount such an object would sell for in U.S. dollars, and the number of people spending time in the virtual world, the virtual world of Everquest had a gross domestic product roughly equivalent to Bulgaria on a per capita basis, and roughly equivalent to Namibia on a total output basis.[92] The hourly wage for playing Everquest, and thereby acquiring virtual world objects, was around three U.S. dollars.[93]

Beneath the visual representation, virtual worlds and virtual world objects are essentially code, code that, for example, defines what in-world actions the player can effectuate if their avatar has a particular object. Underlying the code are massive databases. The acquisition of, or loss of, a virtual world object by an avatar is accomplished below the surface by a changed database entry, as one commentator pointed out in describing the transfer of a virtual sword:[94]

> In fact, in the case of Everquest, you are not even moving a copy of the sword's information. You are only moving a *pointer* to the sword's information, because in practice, there is only one sword defined in a template database. Each local copy is an illusion; your inventory says "you have Sword X." . . . The same is true for that clothing you purchased in Pangya or that chair you bought in Habbo.[95]

Because they are creatures of code, these virtual world objects are subject to a relatively powerful system of rights management. The files that code for the virtual world objects are, in most cases, located on the player's computer. However, the player's avatar cannot use or control the object unless authorized, through the proper database entries, by controllers of the virtual world. In this way, the virtual world controllers can use the underlying technology to dictate whether and how a player's avatar can use virtual world objects. Thus, by controlling the underlying code and database authorizations, the

---

[92] Castronova, *supra* note 91, at 34.

[93] *Id.*

[94] Raph Koster's Website, Are Microtransactions Actually the Future? http://www.raphkoster.com/2006/11/24/are-microtransactions-actually-the-future/ (last visited Apr. 1, 2008).

[95] *Id.*

controllers of virtual worlds can exercise powerful rights management over virtual world objects.

C. INSIDE-OUT: VIRTUAL WORLDS AS UBIQUITOUS COMPUTING EMULATORS

So, why discuss virtual worlds in an article about ubiquitous computing? Because the similarities between virtual worlds and ubiquitous computing environments warrant extrapolating issues from virtual worlds to a world of ubiquitous computing.[96] This extrapolation is particularly useful because virtual worlds are presently observable and populous enough to allow for the observation of potential emergent behavior.[97]

In some ways, the concept of a virtual world and the concept of ubiquitous computing are diametrically opposed to one another; the former seeks to create a world within a computer, while the latter seeks to place computers throughout the world. This difference was acknowledged early in the development of the idea of ubiquitous computing.[98] In fact, this difference led early researchers to refer to ubiquitous computing as "embodied virtuality."[99] A virtual world, as a world of virtual embodiments might be thought of as a ubiquitous computing world turned inside-out, just as a ubiquitous computing world might be seen as a virtual world turned inside-out. While the term "embodied virtuality" was meant to emphasize the differences, it also highlights the similarity between the two: both are computer mediated. In fact, it can be argued that computer mediation is the defining characteristic of both virtual worlds and ubiquitous computing.

---

[96] For example, observations from the conflicts over property rights in virtual world objects inform the examination of the proposition that the emergence of ubiquitous computing technology could lead to the displacement of property rights in real world objects. *See* Part III.C.2. *infra* notes 152–208.

[97] Emergent behavior is the process by which a number of simple entities "operate in an environment, forming more complex behaviors as a collective." Wikipedia, Emergence, http://en.wikipedia.org/wiki/Emergence (last visited Apr. 1, 2008).

[98] The early comparisons were to virtual reality, which were similar if not exactly identical in focus to virtual worlds. *See* Weiser, *supra* note 19.

[99] *Id.*

The transition to a ubiquitous computing world envisions a path of ever-increasing mediation of the physical world by computing ability. The end of that potential path is a physical world completely mediated by computing ability. Thus, the ultimate trajectory of ubiquitous computing can be understood to be where a virtual world is today–a world completely mediated by computers. And while the physical world may never reach the end of that path, each step along the path, each step towards more computer mediation, and thus, more ubiquitous computing, makes the physical world more similar to a virtual world.

Comparing the characteristics of a virtual world with the characteristics sought by ubiquitous computing bears this equivalence out. In creating a simulated virtual environment in which users can interact while sharing one space, a virtual world is by necessity and by its nature "ubiquitous." This is particularly true with respect to objects, both virtual and ubiquitous. The capabilities sought after for objects in a ubiquitous computing environment exist with respect to virtual world objects.

The ubiquitous characteristics that spring from high levels of embeddedness and connectivity are present in virtual worlds because the virtual world exists entirely within a computing system. Embeddedness in a ubiquitous computing setting refers to computing ability being inherent within individual objects, whether those objects are cars, walls, houses or office buildings. Virtual world objects share that characteristic because they are creations of computers, existing only within computers. Thus, computing ability can be brought to bear on the functioning of virtual world objects just as computing ability can be brought to bear on the functioning of physical objects embedded with computers. Similarly, because virtual world objects exist within a computer, and therefore, essentially share a brain, the objects are effectively interconnected; in other words, they share information about each other because the information is stored and processed by the same computer.

Another characteristic of physical objects in a ubiquitous computing environment is that the objects are virtualized; in other words, the objects can be individually identified and located by computers in the environment. All virtual world objects are already "virtualized"; in other words, all virtual world objects are computer readable and subject to a perfect locative system. Without making those characteristics inherent in virtual world objects, the computing system that creates the virtual world would not know where to visualize the objects within the virtual environment. These characteristics also make information chronicling possible for virtual world objects; in fact, some level of information chronicling is

required in order to make the virtual space persistent. The technology of virtual worlds, essentially a combination of software code and massive databases, makes the creation of a virtual Domesday Book a relatively trivial exercise; similarly, ubiquitous computing technology with its "virtualization" of objects makes the same possible in the real world.

Virtual worlds also emulate a ubiquitous computing environment's ability to act autonomously and dynamically in response to defined occurrences and contexts. Stated another way, virtual worlds also emulate a ubiquitous computing environment's ability to control objects. In order to allow avatars to interact with the virtual world environment and with each other within a shared space, virtual worlds create their own "physics." At its most basic, virtual world physics operate to keep two avatars from occupying the same space in the shared environment. In a situation in which two players direct their avatars into the same space, the virtual world computing system overrides the directions of at least one of those players in order to emulate the real world physics that two objects cannot occupy the same space.[100] Similarly, if a player wishes to act on an object in the virtual environment through his avatar, the computing system underlying the virtual world must be able to sense that action and have the virtual world object respond in a dynamic and intelligent manner.

Thus, the very nature of virtual worlds as shared, persistent, computer mediated spaces leads them to emulate ubiquitous computing environments. A virtual world that is, by its very nature, completely computer mediated can be seen as having equivalence to a world in which computing ability has invaded every aspect of life–in other words, a ubiquitous computing world. This, combined with the fact that virtual worlds are populous enough to reveal potential emergent phenomena, makes virtual worlds useful in studying the potential effects of widespread implementation of ubiquitous computing technology. While care should be taken with extrapolation, virtual worlds that seek to mimic characteristics of the physical world seem particularly well-suited as emulators of objects in ubiquitous computing environments.

---

[100] At least with respect to Newtonian physics, two objects cannot reside in the same space. The author makes no representations about what is possible under theories of quantum physics. The author leaves that to Heisenberg, Einstein and Hawking.

III. LEGAL ISSUES ARISING FROM UBIQUITOUS COMPUTING

Ubiquitous computing will undoubtedly create many effectively novel legal issues, some readily apparent, others not. While many of the legal issues that will be raised by ubiquitous computing technology are undoubtedly difficult to discern presently, two issues raised by ubiquitous computing have begun to be discussed. Those two issues are the technology's threat to personal privacy and the potential loss of Fourth Amendment protections that follows such losses in personal privacy.[101] Both have been addressed in academic literature, including legal academic literature.[102] A third potential issue created by ubiquitous computing that is much less obvious relates to property rights as a means of determining rights between parties. Ubiquitous computing could create an environment that would permit the displacement of property rights by private ordering systems.

A. PRIVACY

A world in which ubiquitous computing is a reality brings into the physical world all of the privacy problems created by the Internet. The very nature of the Internet as an information system creates privacy problems. Each action taken by an Internet user online, each link clicked, each page downloaded can be, and usually is, logged. A great deal of information about a user's online actions can be collected quite easily. Activities, which in the physical world traditionally have not led to the collection of potentially private information, can and do lead to such collection online. The classic example is shopping. In the physical world, a trip to the mall does not generally lead to the collection of much, if any, information about the shopper. No one records when the shopper enters the mall, what stores the shopper enters, which items the shopper examines, and which items the shopper purchases with cash.

In the online world, each of the equivalent actions becomes a piece of information about the online shopper that can be captured. When

---

[101] The loss of privacy can also potentially implicate First Amendment rights related to speech and association. *See* Doug Campbell, *RFID and the United States Regulatory Landscape in* RFID: APPLICATIONS, SECURITY, AND PRIVACY 99, 113 (Simson Garfinkel & Beth Rosenberg eds., 2006) (discussing policy concerns associated with privacy loss resulting from widespread RFID implementation). Additionally, Professor Kevin Werbach has discussed a number of other legal implications arising out of increasingly pervasive sensor networks. *See* Werbach, *supra* note 12.

[102] *See* sources cited *supra* note 12.

the online shopper logs on, what shopping sites are visited, which items are clicked on, and which items are purchased can be automatically recorded.[103] Theoretically, an individual could capture most of the same data by following each shopper in a physical mall like some obsessive private investigator and making notes of all the actions taken by that shopper, but such an endeavor would be highly impractical and inefficient. The nature of the Internet removes that impracticality and inefficiency. When each online action by definition involves the transmission of information, the collection of information becomes virtually effortless. Thus, the Internet gives rise to a greatly increased and eased capability for obtaining information about a user that was not traditionally collected in an analogous physical world scenario.

As one might expect from an "internet of things," ubiquitous computing technology will create in the physical world the same information collection possibilities that exist in the online world.[104] The Global Positioning System ("GPS")[105] locator in the shopper's car and cellular telephone will allow the collection of information on which mall the shopper frequents and when the shopper frequents it. Radio Frequency Identification ("RFID")[106] technology, GPS equipment, and computer-aided recognition systems will monitor where the shopper travels in the mall including monitoring which stores the shopper enters and which displays the shopper pauses in front of. Embedded RFID tags will allow automated systems to record which items the shopper takes to dressing rooms, and as the shopper casually waves an RFID-enabled key fob[107] at the purchase station to effect a purchase, the items purchased are recorded.[108]

---

[103] *See* Jerry Kang, *Information Privacy in Cyberspace Transactions*, 50 STAN. L. REV. 1193, 1198–99 (1998).

[104] Kang & Cuff, *supra* note 12, at 105–07; Saadi Lahlou, Marc Langheinrich, & Carsten Rocker, *Privacy and Trust Issues with Invisible Computers*, 48 COMMN'S OF THE ACM 59 (Mar. 2005), *available at* http://portal.acm.org.proxy.ohiolink.edu:9099/citation.cfm?doid=1047671.1047705.

[105] For a more detailed discussion, *see infra* notes 215–20 and accompanying text.

[106] For a more detailed discussion, *see infra* notes 211–13 and accompanying text.

[107] One of the most successful ubiquitous technologies already in wide use is just such a system—the Octopus smart card system in use throughout Hong Kong. GREENFIELD, *supra* note 1, at 215–16 ("The cards are anonymous [in the sense of being universally exchangeable like cash], as good as cash at an ever-growing number of business[es], from Starbucks to local fashion retailer Bossini. You can use Octopus at vending machines, libraries, parking lots, and public swimming pools. It's quickly replacing keys, cards and

However, unlike the online world, the loss of privacy can continue after purchase in a ubiquitous computing world. In fact, privacy proponents see post-purchase use of technology, such as RFID, as more troubling than pre-purchase use.[109] If a purchased item has a unique identification and if the item is linked to the individual at the time of purchase, which would likely be the case, then the item becomes a means of tracking the individual; any time the item's identification is sensed, information about the purchaser is obtained.[110]

While data collection in a ubiquitous computing world can be analogized to data collection in the online world, the data collected in a ubiquitous computing world will differ both quantitatively and qualitatively from present data collections.[111] Quantitatively, an unprecedented amount of data will be collected as sensor-connected computers blanket the physical world and as objects in the physical world are tagged for automated recognition. The data will be qualitatively different in several ways. First, the action of data collection itself will be practically invisible, fading into ordinary daily

---

otherwise, as the primary means of access to a wide variety of private spaces, from apartment and office buildings to university dorms .... According to the Octopus consortium, 95 percent of Hong Kong citizens between the ages of 16 and 65 use their product; you don't get much more ubiquitous than that. As of late 2004, the last period for which full figures are available, Octopus recorded some eight million transactions a day—more, in other words, than there are people in the city.").

[108] Even this last aspect of a ubiquitous computing world—a "smart" payment system—by itself can have an enormous impact on privacy. A study from the 1970s sought to devise the cheapest and easiest way of monitoring all the citizens of a particular country. The study found that a system whereby all transactions occurred through a real-time electronic transfer of funds would be the best way of monitoring individuals comprehensively. *See* Robert Ellis Smith & Mikhail Zolikoff, *Citizens: Getting at Our Real Concerns, in* RFID APPLICATIONS, SECURITY, AND PRIVACY 413 (Simson Garfinkel & Beth Rosenberg eds., 2006).

[109] *See id.* at 415 (arguing that the most significant threat to privacy occurs with RFID-tagged consumer goods after the point of sale).

[110] *Id.* at 419 ("To the extent that the identity of an item can be linked to the identity of a purchaser, the consequences can affect the welfare of that individual. Imagine if the purchase was made by check, credit card, or debit card. It is easy to make a link. If the purchaser paid by cash but left identifying information for delivery or for warranty protection, it is also easy to make a link .... This link is possible because RFID technology, unlike bar code and other technologies, permits the electronic labeling *of each unique item.*") (emphasis in original).

[111] Lahlou, Langheinrich & Rocker, *supra* note 104, at 59.

activities.[112] After all, having computing disappear into the background is one of the stated goals of the ubiquitous computing movement.[113] Second, data will be collected in the course of activities where it previously has not.[114] The shopping example described above illustrates this point.[115] Third, the data collected will be potentially more intimate as sensors measure indicators of mood such as our heart rate, our level of perspiration, and our walking gait.[116] Fourth, the inherently high level of interconnectivity in a ubiquitous computing world will make data sharing more prevalent, which may in turn make unwanted uses of private information more likely.[117] Finally, because ubiquitous computing technologies will necessarily collect data in order to better function, there need not be any ulterior motive to collect data; in many cases, it will simply be a requisite for the proper functioning of systems.[118]

Just as new information gathering and dissemination technologies in the early twentieth century led Samuel Warren and Louis Brandeis to suggest a right of privacy,[119] the arrival of ubiquitous computing technology may lead to the need to revisit the right to privacy at a fundamental level. Whether the standards of acceptable levels of privacy will lessen as the public becomes acclimated to ubiquitous computing or whether new means, legal or technological, will be implemented to protect privacy are interesting issues in and of themselves, but are beyond the scope of this article.[120]

---

[112] *Id.*

[113] Weiser, *supra* note 19.

[114] Kang & Cuff, *supra* note 12, at 145 (In response to this new capability, Kang & Cuff suggest maintaining a "public sphere.").

[115] *Supra* notes 57–58 and accompanying test; *see also* Kang & Cuff, *supra* note 12, at 118–19.

[116] Lahlou, Langheinrich & Rocker, *supra* note 104, at 59.

[117] *Id.*

[118] *Id.*

[119] Samuel Warren & Louis Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193 (1890–91).

[120] *See generally* Kang & Cuff, *supra* note 12.

B. THE FOURTH AMENDMENT

The advancement of technological possibilities brought about by ubiquitous computing will, like previous advances in technology, challenge the capabilities of Fourth Amendment jurisprudence.[121] These potential challenges to the protections provided by the Fourth Amendment flow directly from the loss of privacy[122] likely associated with ubiquitous computing technology.

At its most basic level, the Fourth Amendment covers all searches and seizures made by government actors and contains "a prohibition against unreasonable searches and seizures, and a requirement that probable cause support each warrant issued."[123] The origin of the Fourth Amendment might be very simply described as an attempt to give legal recognition to the idea that "a man's home is his castle." The warrant requirements of the Fourth Amendment were intended to prevent unreasonable "assault on that castle." With ubiquitous computing, however, the invaders are already inside the castle walls, perhaps quite literally in the case of computer-connected sensors embedded in the walls themselves.

Ubiquitous computing technology presents two basic scenarios in which personal information previously protected by the Fourth Amendment might lose protection. The first is the increased ability of the government, through the use of new technologies, to acquire information either previously uncaptured or previously contained within a protected physical space. This technological scenario can be seen as analogous to *Kyllo v. United States*,[124] in which new technologies (thermal imagers) allowed the government to capture information previously uncaptured (the amount of heat escaping from a house).[125] For example, a person's presence, or lack thereof, in a particular location could be recorded in a ubiquitous computing

---

[121] Brenner, *supra* note 12, at 3.

[122] *Supra* notes 104–21 and accompanying text.

[123] Leslie A. Maria, *Investigation and Police Practice: Overview of the Fourth Amendment*, 86 GEO. L.J. 1187, 1198 (1998).

[124] Kyllo v. United States, 533 U.S. 27 (2001).

[125] *Kyllo*, 533 U.S. at 29–30. Although *Kyllo* held that the use of the technology violated the Defendant's Fourth Amendment rights, the Court's opinion was less clear about whether the expectation of privacy would continue as the technology became more commonly available.

environment. In a non-ubiquitous computing environment, that information would most often be uncaptured, absent a witness or some other physical evidence.

The potential for greater information capture can also be seen as analogous to, or even a future extension of, the line of cases dealing with communication technologies. Just as previous communication technologies, from pen and paper mail[126] to the telegraph[127] to the telephone,[128] provided opportunities for the government to acquire information while it was in transit, ubiquitous computing technologies, particularly those aspects of ubiquitous computing involved in sensing, storing, and transmitting data, create new opportunities for the government to intercept information.[129]

In the second scenario in which previously protected information might lose Fourth Amendment protection, the government obtains privately gathered information from third parties. As seen above in the discussion on privacy protection,[130] ubiquitous computing technology has the potential to capture immense amounts of information. Additionally, the inherent interconnectivity of ubiquitous computing makes it so that the captured information may often be in the hands of one or more third parties. The government, in turn, may acquire the collected information from those third parties and, thereby, potentially circumvent Fourth Amendment protections generally associated with that information.[131]

The second scenario presents a further concern for Fourth Amendment protections. Rather than obtaining from third parties data about a specific suspected individual, the government could search for certain patterns of characteristics or profiles of behavior within the large amounts of data collected by third parties. This harvesting of information from private entities in search of suspects more closely resembles a general warrant, eviscerating the specificity

---

[126] *Ex parte* Jackson, 96 U.S. 727 (1878).

[127] *See* Brenner, *supra* note 12, at 12–17.

[128] Katz v. United States, 389 U.S. 347 (1967); Olmstead v. United States, 277 U.S. 438 (1928).

[129] Brenner, *supra* note 12, at 46–50.

[130] *See supra* notes 104–21 and accompanying text.

[131] Brenner, *supra* note 12, at 53–56.

and scope requirements of Fourth Amendment warrants.[132] One of the primary protections afforded by the Fourth Amendment is the specificity limitation placed on the government. Warrants allowing for searches are to be issued only for specific individuals. This specificity requirement was designed to protect individuals from the abuse of general warrants, such as those commonly issued in 17th and 18th century England. Data mining the information collected by ubiquitous computing technologies could bypass the protections provided by the specificity limitation. The collection of information inherent to a ubiquitous computing environment makes this data mining approach a possibility.

As with the area of privacy, ubiquitous computing technology will present multiple challenges to Fourth Amendment jurisprudence. These challenges as well as suggestions for dealing with those challenges have begun to be addressed elsewhere.[133]

C. PROPERTY RIGHTS

Beyond the two related areas of privacy and Fourth Amendment protections, other legal implications of the rise of ubiquitous computing are not so immediately identifiable.[134] This article seeks to identify one additional area of the law potentially impacted by ubiquitous computing–property rights. More specifically, ubiquitous computing makes possible interference with the exercise of personal property rights and the displacement of personal property rights as an ordering system.

---

[132] *Id.* at 62–63.

[133] *See generally,* Brenner, *supra* note 12.

[134] Non-legal commentators have recognized other possible social problems, but have not necessarily connected those with legal issues. For example, Spiekermann and Pallas have described something very close to what is described in this section. They write, "[y]et, pervasive monitoring and the loss of information's natural ephemeral nature are not the only social threats inherent in Ubicomp environments. As Mark Weiser pointed out in his famous article on the computer of the 21st century: 'The [social] problem [associated with Ubicomp], while often couched in terms of privacy, is really one of control.'" Spiekermann & Pallas *supra* note 66, at 3 (quoting Weiser, *supra* note 19).

1. THE TECHNOLOGICAL POTENTIAL FOR INTERFERENCE WITH AND DISPLACEMENT OF PROPERTY RIGHTS

By making remote monitoring and control of objects both possible and practical, ubiquitous computing technology may create the ability to interfere with or prevent uses that have been traditionally viewed as exercises of personal property rights. This ability to interfere provided by ubiquitous computing may make possible the redistribution of personal property rights and the displacement of property as a rights ordering system.

Ubiquitous computing technology gives someone other than the possessor of an object the ability to monitor and control the use of that object. Embedded, sensor-filled environments enable automated monitoring of computer–readable, "virtualized" objects. The ability of the ubiquitous computing environment to respond in a dynamic and autonomous manner allows use of an object to be restricted where technology-based controls are possible. Where such control cannot be had through technology alone, control can be had by overlaying the ability to autonomously monitor the object with a contractual scheme. In fact, the same information technology present in such an environment makes the formation of contracts much easier.[135] Ubiquitous computing technology may, thereby, allow easy contract formation, which will alter traditional property rights, and automated remote monitoring and direct control of real world objects.

As illustrations of the possibilities, consider two examples from creative works: Philip K. Dick's money-grubbing door and the installation artwork titled SeatSale. The first is illustrated by the following conversation between the protagonist and his front door[136] in Philip K. Dick's short story, *Ubik*:

> The door refused to open. It said, "Five cents, please."
>
> He searched his pockets. No more coins; nothing. "I'll pay you tomorrow," he told the door. Again he tried the knob. Again it remained locked tight. "What I pay you," he informed it, "is in the nature of a gratuity; I don't have to pay you."

---

[135] Consider the ease of forming fully enforceable click-wrap or click-through contracts.

[136] While a front door would typically be a fixture, and thus considered part of the real property, the concept of interference with the exercise of property rights by advanced technology is essentially the same.

> "I think otherwise," the door said. "Look in the purchase contract you signed when you bought this [condominium]."
>
> In his desk drawer, he found the contract . . . . Sure enough; payment to his door for opening and shutting constituted a mandatory fee. Not a tip.
>
> "You discover I'm right," the door said. It sounded smug.
>
> From the drawer beside the sink [he] got a stainless steel knife; with it he began systematically to unscrew the bolt assembly of his [condominium's] money gulping door.
>
> "I'll sue you," the door said as the first screw fell out.
>
> [He] said, "I've never been sued by a door before. But I guess I can live through it."[137]

Philip K. Dick's fictional account provides us with a humorous example of how a "smart" object can interfere with an individual's exercise of traditional property rights, in this case the simple use of his front door.[138] The door is able to sense that it is about to be used and who is about to use it. The door is then able to act apparently autonomously in requesting payment and in notifying the potential user of the previously executed purchase agreement. In addition to the technological control component, Dick's account also identifies another component in the potential displacement of personal property rights: the contract. Contracts provide a tool by which a producer of an object can bring the power of the government to bear on a purchaser. Contracts give the producers the ability to interfere with activities that have traditionally fallen within the realm of exercising personal property rights by bridging the distance between the technological ability to monitor and the technological ability to restrict use. In other words, while the door cannot prevent the protagonist from circumventing the payment requirement by removing the door's

---

[137] PHILIP K. DICK, UBIK 24 (1991, originally published in 1969). With gratitude to Adam Greenfield who first brought this passage to my attention in his book, *see* GREENFIELD, *supra* note 1.

[138] A more modern rendition would probably involve automatic micropayments made whenever the door was used, but that would certainly provide for a much less entertaining story.

screws, the contract provides the door with the ability to bring governmental power to bear in the form of a lawsuit.

The second example is drawn from creative endeavor and is artwork titled SeatSale.[139] The artwork consists of a chair that required periodic license agreements in order to be able to sit in it.[140] The standard wooden chair's seat contained a number of holes through which sharp metal spikes could extend upward or retract downward. The mechanism that extended and retracted the metal spikes was connected to a credit card reading machine. Connected Light Emitting Diode ("LED") and Video Graphics Array ("VGA") displays provided information on when a credit card needed to be swiped through the reader in order to prevent extension of the spikes. After a set amount of time, the VGA display flashed the following sequence of four messages:

> **WARNING!**
>
> Your Seating License WILL EXPIRE in 5 seconds! Please get off the chair when the buzzer sounds!!!
>
> Your Seating License will expire in 4 seconds Please swipe your credit card or contact the SeatWorks to renew your license
>
> WARNING: Your Seating License will expire in 3 seconds! Please get off the chair! Contact the SeatWorks to renew your license.
>
> License Expired.[141]

If a credit card was not swiped within the required time period and the seating license expired, the metal spikes would extend upward through the holes in the chair's seat, making use of the chair as an

---

[139] Steve Mann, *SeatSale: License to Sit*, http://wearcam.org/seatsale (last visited Apr. 1, 2008). The artwork was exhibited in a number of museums including the San Francisco Art Institute, Austin Museum of Art, and Oklahoma City Museum of Art. Bruce Schechter, *Real-Life Cyborg Challenges Reality with Technology*, N.Y. TIMES, Sept. 25, 2001, at F4.

[140] Mann, *supra* note 139 ("Here is the Internet Chair with magnetic stripe card reader and spikes that retract when a seating license is downloaded from a license server in response to input from the card reader incoroporated [sic] into the chair.").

[141] *Id.*

object on which to sit problematic.[142] Even though SeatSale does not present itself as a likely future product, it does serve as a rather pointed example of the capability of using technological means to control the use of an object.

Contracts could, of course, be used alone to attempt to control the use of objects and, thus, to alter the allocation of traditional property rights. Possession of an object could be transferred in conjunction with a license agreement that specified exactly what the new possessor could and could not do with respect to the object.[143] However, once the object is out of the sight of the transferor, who may retain the property rights but does not retain possession, it will be very difficult or impossible for the transferor of the object to determine whether the possessor has followed the license agreement.

What increased ubiquitous computing technology makes possible is both monitoring and control of the object in a manner efficient enough to make it potentially practicable and profitable to alter the traditional allocation and transfer of property rights. Ubiquitous computing technology provides the ability and contract principles make it legally effective. For example, contracts can provide a means of control by imposing consequences upon the user if monitoring detects certain events. Thus, if a contract provided for a $500 fee for using an automobile on Sunday, and if the automobile's operation was monitored by an automated information system, the control over the use and enjoyment of that property would be provided by the contract. Of course, the other option, employing technology to control the use, would simply involve a technological mechanism that would disable the automobile on Sundays.

Some combination of contract and technological control could also be used. The car could be disabled until the user actually paid whatever fee was previously or concurrently set for that type of use. But it is important to remember control could also be accomplished through purely technical means. For example, the speed of automobiles could be monitored by GPS while the same GPS equipment would provide location information. The automobile's particular location could be linked with known speed limits for that area, and the entire system, which includes the automobile, could then

---

[142] *Id.* ("You can help by keeping a watchful eye on our infrared security cameras to help us prevent theft of Seating Services (TM), and to prevent the smuggling of contraband (pillows, boards, and other tools of license circumvention), into the museum space.").

[143] A rental agreement for an automobile does exactly that.

regulate the speed of the car downward to match the stored information regarding the allowed speeds.[144]

This level of technological and contractual control that impinges on the exercise of the user's traditional personal property rights is even easier to envision when the individual objects are not considered separately. Rather, the ability to monitor and control is easier to see when such future objects are considered as parts of a world of objects that communicate with each other and as parts of a world that is universally networked and always connected.[145] Objects that work together are rich with possibilities for producers.[146] If the first object of a pair that functions together is able to communicate with the information system of the producer wishing to monitor and control the second object, then the second object need only be able to communicate with the first connected object. By being able to monitor and control the first object, the producer can effectively monitor and control the second object.

As an example, consider a computer–readable, uniquely identified instant Cup O'Soup product,[147] a Styrofoam container to which you add water before microwaving. As a benefit, the Cup O'Soup could transmit to the microwave the settings and length of cooking needed to prepare the soup, but the Cup O'Soup and microwave could also be used together to enforce an expiration date. When the microwave receives a signal from the Cup O'Soup which includes information on the Cup's expiration date or includes identifying information that allows the microwave to retrieve the expiration information from a remote server, the microwave could check that date versus the current date and then "refuse" to cook the Cup O'Soup. Of course, you might be able to get around that control mechanism by boiling water

---

[144] M.S., *Drive Safely–Big Brother is Watching*, WIRED, Mar. 2007, at 78, *available at* http://www.wired.com/wired/archive/15.03/play.html?pg=7 (describing a driver assistance system called Intelligent Speed Adaptation).

[145] The absolutes of "universally" and "always" are not necessary for the points herein to remain valid. Rather, the effects on property rights increase as the degree of connectivity increases. There is most likely some threshold of connectivity that must be crossed before technological controls become commercially beneficial. That threshold is lowered by decreases in the cost of technology and increases in the benefits gained by technological control.

[146] One possible role that RFID can play is to limit functionality by allowing two or more objects to communicate with each other. *See* Campbell, *supra* note 101, at 110.

[147] Using Radio Frequency Identification ("RFID") for example. For more information, *see infra* notes 211–13.

separately and then adding in the Cup O'Soup. So, the manufacturer might include in the container a sensing device that triggers a different signal. When that signal is communicated, the producer may be given the knowledge that the product was used past its expiration date, an act that might have legal and financial consequences. The lid might contain contractual language indicating that opening the Cup O'Soup provides contractual assent and indicating that the user agrees to pay an additional fee for opening the contents past the expiration date, or the microwave might ask the user to assent to "Terms of Use" before allowing the use.

This level of communication and connectivity within what is normally viewed as the private sanctum of the home would be commonplace in a ubiquitous computing environment and is strongly hinted at by even today's "smart" homes.[148] This is especially true if one takes the natural outgrowth of today's "smart" home and incorporates into that the principles of trusted systems. Industry efforts to push for trusted systems are already seen in media industries where these questions are already clearly identified.[149]

The details of the examples presented herein, from the Sabbath observing car[150] to the Cup O'Soup obsessed with its own expiration date,[151] are not important in a predictive sense. Their role is only to illustrate the interplay between ubiquitous computing technology and the exercise of property rights. It is not necessary to identify the exact conflicts that will arise; it is only necessary to recognize that some conflict between the interests of the producer of an object and its possessor will arise and that ubiquitous computing technology may give the producer of the object the ability to act on that conflict to the possessor's detriment.

---

[148] For examples of smart homes see Pluto Homes, http://plutohome.com/index.php? (last visited Feb. 26, 2008); *see also* Aware Home Research Initiative, A Residential Laboratory at Georgia Institute of Technology, http://awarehome.imtc.gatech.edu (last visited Apr. 1, 2008); RAND, Beyond the Internet, http://www.rand.org/scitech/stpi/ourfuture/Internet/section4.html (last visited Apr. 1, 2008) ("This section will explore the prospects and potential of a *second wave of connectivity*, where "intelligence" is embedded in the objects and materials of our daily lives—appliances, automobiles, homes, and even clothing—that are interconnected. This will create large, pervasive networks . . . .") (emphasis in original); The Laboratory Shaping Our Future, CNN, Dec. 2, 2004, http://www.cnn.com/2004/BUSINESS/12/02/csail.oxygen/index.html.

[149] The Broadcast Flag rulemaking proceedings are a prominent example.

[150] *See supra* note 144 and accompanying text.

[151] *See supra* notes 147–48 and accompanying text.

2. INFERENCES FROM PROPERTY RIGHTS DISPUTES INVOLVING VIRTUAL WORLD OBJECTS

While it may be some time before advancing technology in the form of ubiquitous computing forces these questions upon us in the context of personal property in the physical world, many of these questions are currently being raised by the growing debate over property rights in virtual world objects.[152] Therefore, examining the debate over property rights in virtual world objects will help clarify the important issues.

While, at first glance, they seem to be completely different, virtual worlds may provide additional support for the proposition that ubiquitous computing will allow interference with actions traditionally viewed as exercises of personal property rights. In concept, virtual worlds are the exact opposite of a ubiquitous computing environment. Ubiquitous computing spreads interconnected computing ability throughout the physical world. In contrast, virtual worlds attempt to put the physical world inside a computer. Despite this conceptual difference, however, virtual worlds may serve as useful emulators of ubiquitous computing environments because both virtual worlds and ubiquitous computing environments are mediated by computing ability.[153] Examination of property rights issues surrounding virtual world objects may, therefore, be beneficial in predicting how similar issues may arise from ubiquitous computing.

Unlike physical objects with which the existence of personal property rights is presumed, the existence of personal property rights with respect to virtual world objects is anything but presumed. While many in the financial world think that anything that someone will pay money for is property, those in the legal world may look at the question of whether virtual world objects are subject to property rights more critically. Incidents between players, and between players and the corporate controllers of virtual worlds, have raised the question of the property rights status of virtual world objects. One of the earliest well-known incidents raising the question was the Blacksnow incident. A group of experienced players decided to take

---

[152] *See, e.g.*, Joshua A.T. Fairfield, *Virtual Property*, 85 B.U. L. REV. 1047 (2005); F. Gregory Lastowka & Dan Hunter, *The Laws of Virtual Worlds*, 92 CAL. L. REV. 1 (2004); Richard A. Bartle, *Pitfalls of Virtual Property* (The Themis Group, White Paper, 2004), *available at* http://www.themis-group.com/uploads/Pitfalls%20of%20Virtual%20Property.pdf.

[153] *See* Part II.C. *supra* notes 96–98.

advantage of two realities: the real world value of virtual world objects and the low wages for which workers in poorer countries would work.[154]

Entire markets for virtual world objects have developed extensively, primarily on Internet auction sites.[155] Many players are willing to pay real money for virtual world objects. A player whose avatar has a particular virtual world object runs an auction through an Internet auction site. After the winner of the auction pays real world currency to the selling player, the two players' avatars meet within the virtual world and the seller's avatar gives the purchaser's avatar the virtual world object. Such a transfer is generally called a "Real Money Transfer." The trade is so extensive that economists have been able to calculate per capita GNP for virtual worlds as well as hourly earning potential for players in virtual worlds.[156]

In order to take economic advantage of this market for virtual world objects, the Blacksnow group set up a "click-and-sweat" shop in Tijuana. They paid low wages to workers to play Dark Age of Camelot for the sole purpose of acquiring saleable virtual world objects.[157] The group would then sell the items to other players through eBay auctions.[158] The corporate owners of Dark Age of Camelot became involved to stop the sales and successfully got eBay to pull the

---

[154] *See* Allen Chein, Note, *A Practical Look at Virtual Property*, 80 ST. JOHN'S L. REV. 1059, 1090 n. 23 (2006).

[155] *See* Julian Dibbell, *The Unreal Estate Boom*, WIRED, Jan. 2003, www.wired.com/wired/archive/11.01/gaming.html; Mark Ward, *Making Money from Virtually Nothing*, BBC ONLINE NEWS, Aug. 11, 2003, http://news.bbc.co.uk/1/hi/technology/3135247.stm.

[156] Edward Castronova, *Virtual Worlds: A First-Hand Account of Market and Society on the Cyberian Frontier*, (CESifo Working Paper Series No. 618, 2001), *available at* http://ssrn.com/abstract=294828; Clive Thompson, *Game Theories*, WALRUS, June 2004, http://walrusmagazine.com/article.pl?sid=04/05/06/1929205; Mark Ward, *Virtual Gaming Worlds Overtake Namibia*, BBC ONLINE NEWS, Aug. 19, 2004, *available at* http://news.bbc.co.uk/go/pr/fr/-/2/hi/technology/3570224.stm.

[157] Julian Dibbell, Black Snow Interactive and the World's First Virtual Sweat Shop (Jan. 2003) (unpublished manuscript, on file with author), http://www.juliandibbell.com/texts/blacksnow.html.

[158] This practice is referred to by gamers as "farming." Because "farming" can interfere with the ability of other players' avatars to interact with parts of the virtual world, hostile feelings towards "farmers" can arise among normal players. There have been instances of large numbers of players banding their avatars together to attack and chase off the avatars of those engaged in "farming."

auctions.[159] The owners also brought legal action against the Blacksnow group; however the suit was never resolved.[160] The Blacksnow incident is important for two reasons. First, it squarely raised the issue of property rights, namely the right of alienation, with respect to virtual world objects. Second, it greatly raised awareness of the issue of property rights in virtual world objects among players and among the corporations that run virtual worlds.

A lesser known incident—at least lesser known in the United States—also raised the question of the property rights status of virtual world objects. This incident took place in a primarily Asian virtual world, and the resulting litigation took place in China.[161] A Chinese player spent a considerable amount of time playing a MMORPG, and in the process, developed an avatar that was very powerful within the virtual world. Much of this power came from various rare virtual world objects acquired by the avatar during play. One day, the player logged into the game to discover that all of the objects he had worked so long to acquire and that had made his avatar so powerful were gone. Another player had hacked the game and taken those objects. Eventually, this led to a lawsuit between the player and the corporation that ran the virtual world.[162] The court ended up

---

[159] "Farming" businesses such as these are seen as an acceptable and viable business model in much of East Asia. In fact, Julian Dibbell, in a recent blog entry on terranove.blogs.com, has questioned whether these businesses can really be referred to as sweatshops. He has also questioned whether proper evidence of the existence of such businesses has been brought forth yet. Julian Dibbell, *Will the Real Virtual Sweatshop Please Stand Up?*, TERRA NOVA, Feb. 8, 2005, http://terranova.blogs.com/terra_nova/2005/02/will_the_real_v.html.

[160] Michele Mandel, *Money for Nothing: Michele Mandel Reports Big Game Hunters are Getting Rich in the Cyber Jungle*, TORONTO SUN, Mar. 13, 2005, http://www.canoe.ca/NewsStand/Columnists/Toronto/Michele_Mandel/2005/03/13/959227.html.

[161] MMORPGs appear to be as popular if not more popular in Asia than in the United States or Europe. For example, Terra Nova lists seven MMORPGs in Asia, each of which have over one hundred thousand players: Legend of Mir, Final Fantasy IX, Lineage, Lineage II, MU Online, Ragnorak Online, and Kingdom of the Winds. Mike Seller, *A Numbers Game*, TERRA NOVA, Jan. 9, 2006, *available at* http://terranova.blogs.com/terra_nova/2006/01/the_numbers_gam.html.

[162] As is often true in the real world, the actual case was more complex by the time it reached litigation. After the corporation refused the player's requests to reinstate the objects, the player went out and used a hack himself to regain many of the objects. In response to his use of the hack, the corporation canceled his account. At that point, it turned into litigation between the player and the corporation.

concluding that the player had lost something for which the corporation should compensate him (presumably in-game).[163] So, the loss of virtual world objects alone was a compensable loss, at least to the extent a court would exercise its power to force the payment of compensation.[164]

A third incident that raised the question of the legal status of virtual world objects arose in the context of whether defrauding an individual of virtual world currency is a crime. The Gaming Open Market Corp., [165] or "GOM" as it is more commonly known, operates as a trader of virtual world objects. Its primary role is that of an escrow agent that provides an easy to find centralized location for the exchange of virtual world objects. A new customer used the PayPal service to purchase 3,000 U.S. dollars worth of Linden Dollars, the virtual currency of the virtual world Second Life.

As soon as the Linden Dollars were delivered to the purchaser's avatar within Second Life, the customer told PayPal that he had not received the virtual currency and demanded that PayPal retrieve his $3,000 from GOM and refund it to him. PayPal has a well-known policy that in disputes over the delivery of intangible goods, the risk of loss is always with the seller. Thus, if the purchaser says the intangible goods were not delivered, PayPal retrieves the money paid and refunds it to the purchaser without any further investigation. Thus, by using this policy, the customer was able to acquire the virtual currency in the virtual world and then get his real world money back. GOM did not lose any real world currency; rather, the only thing they lost was a rather large sum of virtual currency. The customer even sent an e-mail to GOM explaining that their loss in virtual currency was "the price for him teaching them a lesson." GOM reported the actions to the FBI as a case of fraud.[166] The incident thus presents the question of whether the defrauding of an individual of nothing but

---

[163] *See* Allen Chein, *A Practical Look at Virtual Property*, 80 ST. JOHN'S L. REV. 1059 (2006).

[164] Jeremy Goldkorn, *Protecting Virtual Private Property in China*, DANWEI, Jan. 11, 2004, http://www.danwei.org/internet/protecting_virtual_private_pro.php.

[165] *See, e.g.*, Mark Ward, *Virtual Cash Exchange Goes Live*, BBC ONLINE NEWS, Jan. 7, 2004, http://news.bbc.co.uk/2/hi/technology/3368633.stm. Other markets for virtual world objects exist such as eBay, SL Exchange, PlayerAuctions, and IGE.

[166] Ren Reynolds, *GOM Off-line*, Terra Nova, Jun. 21, 2004, terranova.blogs.com/terra_nova/2004/06/gom_offline.html.

virtual world objects, virtual currency in this instance, constitutes criminal fraud.[167]

Incidents such as these have raised the question of whether personal property rights exist in virtual world objects. Gregory Lastowka and Dan Hunter have been two of the first legal commentators to examine, from a theoretical standpoint, whether property rights exist with respect to virtual world objects.[168] In brief, their analysis has been two-fold, examining first whether the descriptive characteristics of virtual world objects are consistent with other types of recognized property and second whether traditional normative justifications for property rights apply to virtual world objects.

In the descriptive inquiry, they conclude that the intangibility and potentially short lifespan of virtual world objects are not distinguishable from other types of recognized property. For example, property rights attach to various forms of intellectual property that are intangible and arguably even less distinct and definable than virtual world objects. Lastowka and Hunter point to leaseholds, usufructs, and intellectual property as recognized forms of property which are limited in time; in some cases to potentially short periods of time. They, thus, conclude that virtual world objects are not descriptively distinguishable from other types of property.[169]

In the normative inquiry, Lastowka and Hunter apply the three main normative accounts of property rights: Bentham's utilitarian theory, Locke's labor-desert theory, and the personality theory.[170] They conclude, with a few qualifications, that each of these normative justifications would support the claim that property rights adhere to virtual world objects.[171]

---

[167] Other incidents have also occurred, which may raise the issue of the legal status of virtual world objects. However, because these incidents have occurred within the virtual world, without a real world component, the issues they raise are confounded by the argument that they are merely part of game play, intended by the designers and implicitly accepted as risks by the players. For example, a player of Eve Online swindled other players out of large amounts of virtual world currency by what was essentially an investment scam. Tudor Stefanescu, *Eve Online Economy Suffers 700 Billion ISK Scam*, SOFTPEDIA NEWS, Aug. 24, 2006, http://news.softpedia.com/news/Eve-Online-Economy-Suffers-700-billion-ISK-Scam-33737.shtml.

[168] *See generally* Lastowka & Hunter, *supra* note 152.

[169] Lastowka & Hunter, *supra* note 152, at 13.

[170] *Id.* at 37.

[171] *Id.* at 49.

Under a utilitarian justification, private property rights exist because recognizing such rights creates the "greatest good for the greatest number."[172] "Thus, we should grant private property interests if doing so would increase overall utility, which is to say, social welfare."[173] With respect to application of this social welfare based justification for property rights to virtual world objects, "societal good is composed simply of aggregate individual goods."[174] With such a conception of societal good, the data on the number of players,[175] the amount of time they invest in acquiring virtual world objects,[176] and the magnitude of real money transfers of virtual world objects,[177] clearly provide a utilitarian argument for property rights in virtual world objects.

Locke's central theory of desert from labor is that "[w]hatsoever [man] removes out of the state that nature hath provided and left it in, he hath mixed his labor with, and joined to it something that is his own, and thereby makes it his property."[178] Lastowka and Hunter conclude that because of the amount of effort players invest in creating and obtaining virtual world objects, a claim for property rights in virtual world objects can be based on a Lockean labor-desert justification.[179] As they say, "anyone who has slaved over a virtual forge will tell you, creating virtual-world property can involve at least as much tedium as any real-world work."[180]

---

[172] *Id.* at 44.

[173] *Id.*

[174] *Id.* at 45.

[175] There are over 15 million estimated players with memberships in MMORPGs. Wikipedia, MMORPGs, http://en.wikipedia.org/wiki/MMORPG (last visited Apr. 1, 2008).

[176] Players spend an average of twenty hours a week playing MMORPGs. Ben Hammersley, *A Virtual Fortune*, GUARDIAN, July 8, 2004, http://www.guardian.co.uk/computergames/story/0,,1256077,00.html.

[177] *See supra* notes 91–93 and accompanying text.

[178] JOHN LOCKE, SECOND TREATISE OF GOVERNMENT § 27, at 17 (Thomas P. Peardon ed., 1952).

[179] Lastowka & Hunter, *supra* note 152, at 46–47.

[180] *Id.* (describing the Lockean justification while responding to the criticism that virtual world players are playing a game as opposed to doing work).

The personality theory of property rights essentially argues that property rights should be recognized not because of any normative justification inherent to property, but because the recognition of property rights helps the self to be realized by protecting human rights such as liberty, identity, and privacy.[181] As virtual worlds naturally facilitate the projection of identity into the virtual space through the avatar, the personality theory seems particularly appropriate for use in providing a justification for property rights in virtual world objects.[182]

Professor Joshua Fairfield has also made the argument for property rights in virtual world objects with a similarly structured approach as Lastowka and Hunter by taking up both descriptive and normative inquiries.[183] First, he describes how virtual world objects mimic the characteristics of real world objects, namely that virtual world objects are rivalrous, persistent, and interconnected.[184] Second, he takes up an economics based normative inquiry by arguing that regulation through a system of property rights produces higher value because common law property rules provide incentives for productive use[185] and because property rights in virtual objects can prevent private anticommons from arising.[186]

Virtual world objects are rivalrous in that one user can exclude others from using a particular virtual object.[187] In other words, virtual world objects are coded in such a way as to allow a possessor to

---

[181] *Id.* at 48. Lastowka and Hunter refer to the personality theory of property rights as deriving from Hegel's conception of personhood. "In Hegel's view, 'property was an extension of personality. Ownership expanded the natural sphere of freedom for the individual beyond his body to part of the material world.'" (quoting Thomas C. Grey, *The Disintegration of Property*, 22 NOMOS 69, 74 (1980) (J. Ronald Pennock & John W. Chapman eds. 1980)).

[182] *Id.* at 48–49 ("If, as personality theory would have it, property might be justified by reference to the effect on the self, it would seem that there is a normative basis for claiming property in virtual realty, virtual chattels, and, a fortiori, avatars.").

[183] Fairfield, *supra* note 152. Professor Fairfield addresses more than simply virtual world objects. He treats virtual world objects together with URLs, chat rooms, and e-mail addresses as being examples of what he calls virtual property.

[184] *Id.* at 1053–55.

[185] *Id.* at 1064–68.

[186] *Id.* at 1069–72.

[187] *Id.* at 1053–54, 1063–64.

prevent others from using the same object. Virtual world objects share the quality of persistence with real world objects because virtual world objects do not cease to exist simply because one user turns off his or her computer.[188] Virtual world objects are also interconnected like real world objects. They can be experienced by multiple individuals. Multiple users can perceive a single virtual world object within a virtual world.[189] Thus, virtual world objects mimic the real world descriptive characteristics of rivalrousness, persistence, and interconnectedness.

Fairfield's economics based justification for property rights in virtual world objects begins by pointing out that the allocation of property rights in newly emerging resources has traditionally occurred to provide incentives for productive use of those resources.[190] However unlike real world spaces where property right allocation is generally seen as a means to prevent a tragedy of the commons, property right allocation in virtual spaces is necessary to prevent a tragedy of the anticommons.[191] If control or rights over emerging virtual resources are divided up between too many users, none may be able to make productive use of the resources, thereby, creating a tragedy of the anticommons.[192] To avoid this situation, Fairfield argues that rights should be allocated in conjunction with productive uses such that a marketable title is created.[193] He distinguishes between potential allocations of property rights by describing rights as either "vertical" or "horizontal."[194]

> A "vertical" property right is one that cuts across all of the various objections and permits the property to be used as a whole. A "horizontal" right is one that is not in itself useful,

---

[188] *Id.*

[189] *Id.*

[190] *Id.* at 1064–67.

[191] *Id.* at 1069.

[192] *Id.*

[193] *Id.* at 1071 ("The common law of property has long sought to unify marketable title in a single person who then has the full incentives to maximize the value, minimize the damage, and alienate the property when someone else can put it to better use.").

[194] *Id.* at 1070 (citing Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 640–42 (1998)).

> but which cuts across vertical rights. For example, if the ownership of a tractor were divided such that one person owned the wheels, another person owned the engine, and a third person owned the steering wheel, a person who wanted to use or buy the tractor as a whole would have to negotiate with three parties to gain any kind of useful right. The right to use the tractor as a whole would be the "vertical right." The right in the wheel has no use value by itself, because the tractor operates at the level of the whole unit. As a result, a right in the wheel is a crosscutting horizontal right, which can be used to prevent use of the tractor as a whole.[195]

If rights are allocated in an emerging resource in such a way that creates horizontal rights, then fragmentation of the ownership of those rights can lead to an anticommons.[196] In applying this analysis to virtual worlds, it is the virtual world objects because of their coded characteristics that are the "vertical" uses.[197]

Despite scholarly interest in whether virtual world objects are subject to personal property rights, the question may remain largely unanswered[198] both because of the ease with which the relative rights of the parties can seemingly be established initially by a contract[199] and because of the level of technological control that can be exercised by virtual world producers.[200] In response to the possibility of player-owned property rights in virtual world objects and the increasing real world sale of virtual world objects exemplified on one extreme by the

---

[195] *Id.* at 1070.

[196] *Id.* ("Fragmentation only creates an anticommons when the resulting property fragments cut across useful rights.").

[197] *Id.* at 1077 ("Since virtual property operates as a unified whole only at the level of code, the appropriate package of property rights also appears at the level of code.").

[198] While the question of the existence of property rights in virtual world objects is certainly an interesting one and worthy of further discussion, it is beyond the focus of this article. Rather, the question of who owns the property rights in virtual world objects, assuming that such rights exist, and the potential implications of the answer to that question for property rights in real world objects are the focus of this article.

[199] *See* Jack M. Balkin, *Law and Liberty in Virtual Worlds*, 49 N.Y.L. SCH. L. REV. 63, 63 (2004–2005) ("rights between players and designers of virtual worlds are primarily determined by contract.").

[200] *See infra* notes 204–08 and accompanying text.

Blacksnow incident, a number of corporations that run virtual worlds have attempted to use the contract between the players and the corporations both to attempt to establish that players do not acquire property rights in virtual world objects and to alter traditional property rights[201]; and, if they do in fact arise, by prohibiting the sale of virtual world objects by players for real world currency.[202]

This contract is typically styled as an End User License Agreement ("EULA").[203] Assent by the end user to lengthy complicated contracts is provided by the click of a mouse, at best, and modifications of the license can be executed each time the player takes the action of

---

[201] Fairfield, *supra* note 152, at 1082–83. Fairfield quotes the World of Warcraft Terms of Use Agreement: "Remember, at the outset of these Terms of Use, where we discussed how you were 'licensed' the right to use [the virtual world], and that your license was 'limited'? Well, here is one of the more important areas where these license limitations come into effect. Note that [the intellectual property holder] either owns, or has exclusively licensed, all of the content which appears in [the virtual world]. Therefore, no one has the right to 'sell' [the IP holder's] content, except [the IP holder]! So [the IP holder] does not recognize any property claims outside of [the virtual world] or the purported 'sale' in the 'real world' of anything related to [the virtual world]. Accordingly, you may not sell items for "real" money or trade items for things of value outside of [the virtual world]."

[202] For example, Blizzard Entertainment, the publisher of a recent popular entry into the MMORPG market, World of Warcraft, issued the following statement on Dec. 10, 2004: "Selling World of Warcraft In-Game Content for Real Money—It has come to our attention that certain individuals are selling Blizzard's in-game property for cash on auction sites such as eBay and on personal websites. The World of Warcraft Terms of Use clearly state that all of the content in World of Warcraft is the property of Blizzard, and Blizzard does not allow "in game" items to be sold for real money. Accordingly, Blizzard Entertainment will take any and all actions necessary to stop this behavior. Not only do we believe that this is illegal, but it also has the potential to damage the game economy and overall experience for many of thousands of others who play World of Warcraft for fun. In order to promote a fun and fair environment for all our customers, we are actively investigating those individuals who engage in this inappropriate activity and reserve the right to take legal action against these individuals to protect World of Warcraft for all those who "play by the rules." If you are found to be selling in-game property (such as coins, items, or characters), for real money, you will lose your characters and accounts, and Blizzard Entertainment reserves its right to pursue legal action against you as well. We also want to remind potential buyers in the game to please refrain from buying in-game property with real money. We understand the temptation to purchase better items, but Blizzard, and not the seller, does own all in-game property. In addition, we feel that characters can find ample equipment and money within the game through their own adventuring and questing. Please understand that if you do purchase in-game property from sellers on eBay and personal sites, we may temporarily suspend your account, and at the very least, delete the offending items." World of Warcraft, Announcements, Dec. 10, 2004, http://www.worldofwarcraft.com/ news/announcements.html.

[203] *See generally* Daniel C. Miller, Note, *Determining Ownership in Virtual Worlds: Copyright and License Agreements*, 22 REV. LITIG. 435, 460–67 (2003).

logging into the world. Since logging into the virtual world is necessary to use the virtual world object, contractual modifications can be mandated any time an attempt is made to use a virtual world object. Technology, which enables rights management of virtual world objects, apparently also enables binding contracts to be formed with little effort on the part of the virtual world owner and with little awareness on the part of the user.

In addition, the technology itself provides another level of control over virtual world objects. Regardless of whether a player owns personal property rights in a virtual world object, the original producers of that object, the producers of the virtual world, can control the use of the object by technological means without recourse to courts. Corporations that run many of today's most populous virtual worlds have regularly removed virtual objects from players' accounts or canceled accounts wholesale when the corporations have disagreed with the actions of the players. This has particularly been the case when players have bought or sold virtual objects for real money.[204] In other words, the virtual world producers have, through technological means, interfered with the exercise of one of the traditional property rights, the right of alienation. Such virtual world producers have in effect created a forfeiture restraint on alienation.[205]

Two other virtual world practices also demonstrate the ability of those controlling virtual worlds to interfere with the exercise of putative property rights in virtual world objects. Those practices are, in virtual world lingo, "soul-binding" and "nerfing." Soul binding links a virtual world object to a single avatar such that it cannot be transferred to another avatar; this largely blocks the ability to alienate the soul-bound object.[206] Nerfing is the practice of changing a virtual

---

[204] For example, Blizzard Entertainment permanently suspended over 1000 World of Warcraft players' accounts where they discovered players, "goldfarmers," were making gold in the game and then selling it for real currency. Steve Parsons, *Blizzard Kills Over 1000 WoW Accounts*, JOYSTIQ, Mar. 13, 2005, http://www.joystiq.com/2005/03/13/blizzard-kills-over-1000-wow-accounts.

[205] *See* RICHARD R. POWELL, POWELL ON REAL PROPERTY § 77.01 (Michael Allan Wolf ed., LexisNexis 2007) (describing a forfeiture restrain on alienation as one that "terminates the property interest, in whole or in part, in the event of a later transfer").

[206] Posting of Tek to Terra Nova: GOM Off-line, http://terranova.blogs.com/terra_nova/2004/06/gom_offline.html (June 27, 2004 20:08:54 EST).

world object's functional characteristics after it has passed into the hands of avatars.[207]

Thus, the technology of virtual worlds allows for property rights in virtual world objects, presuming such rights exist, to be displaced through the use of contract and through the use of direct technology-enabled control. The current state of virtual world objects illustrates two important potential features of future property systems in ubiquitous computing environments: a powerful rights management technology and an extremely efficient contract formation mechanism. The authorization-based rights management system, made possible by the connection of the player's computer and the corporate server, allows the corporation to control directly the use and transfer of the virtual world object. Even though the corporations that run virtual worlds rarely choose to exercise control over transfers through technology-enabled rights management, they are easily able to do so.[208] Current virtual worlds also illustrate that contracts allocating the rights between the player and the corporation can be easily and frequently formed because of the communication abilities provided by the connection between the player's computer and the corporate servers.

On a more generalized level, an examination of the property rights issues associated with virtual world objects demonstrates that the exercise of personal property rights in virtual world objects, if such rights exist, can be hindered through the application of computing ability and that the extent to which computing ability controls virtual world objects allows property as a rights ordering system to be displaced by a privately ordered system dictated by contract and technology. A player's rights in a virtual world object are determined not by traditional property rules, but rather by a private system defined by contract and by computer code.

This displacement has significance beyond virtual worlds; because virtual worlds in many ways mimic ubiquitous computing environments, the result we observe for property rights in virtual worlds may be the result we observe in the future in a ubiquitous computing world. Property rights in the virtualized object of the ubiquitous computing world may follow the fate of property rights in virtual worlds. Ubiquitous computing technology appears to be on the verge of permitting both of these features to be applied to personal

---

[207] Wikipedia, Nerf (computer gaming), http://en.wikipedia.org/wiki/Nerf_%28computer_gaming%29 (last visited Apr. 1, 2008).

[208] Consider the examples of soul-binding and nerfing discussed *supra* notes 206–07.

property in the real world. Technology may soon allow both easy contract formation (altering traditional property rights) and automated remote monitoring of real world objects. Further, ubiquitous computing technology may also soon allow direct technologically-enabled control over the exercise of traditional personal property rights by someone other than the possessor of an object of personality.

3. EVIDENCE FROM EMERGING UBIQUITOUS TECHNOLOGY

The level of technology described as ubiquitous computing[209] may seem unbelievable or the stuff science fiction stories are made of,[210] but currently emerging technology strongly hints at the capability of future technologies to provide the requisite levels of monitoring and control sufficient to interfere with the exercise of personal property rights and to displace property as a rights ordering system. In fact, many of these technologies exist currently, but simply have not yet been put into widespread use.

Radio Frequency Identification ("RFID")[211] technology is capable of virtualizing physical objects. Many potential functions in a ubiquitous computing world depend on the embedded computers

---

[209] *See supra* Part II.A. notes 26–71 and accompanying text, and Part III.C.2. notes 152–208 and accompanying text.

[210] As the citations to Philip K. Dick and Bruce Sterling would seem to indicate. Many of the most frequently cited examples of ubiquitous computing come from prominent science fiction movies, from the advertisements personalized by retinal scan of the gesture controlled interfaces, and the control overrides of mag-lev vehicles of *Minority Report* to urinalysis-capable toilets in *The Island* to the auto-drive features of the cars in *I, Robot*.

[211] For background information. See Simson Garfinkel & Henry Holtzman *Understanding RFID Technology, in* RFID APPLICATIONS, SECURITY, AND PRIVACY 15, 15 (Simson Garfinkel & Beth Rosenberg eds., 2006). For more information, see generally RFID Journal, http://www.rfidjournal.com (last visited Apr. 1, 2008). *See also* Harry A. Valetk, *Mastering the Dark Arts of Cyberspace: A Quest for Sound Internet Safety Policies*, 2004 STAN. TECH. L. REV. 2 (2004); Press Release, Food and Drug Admin., FDA Announces New Initiative to Protect the U.S. Drug Supply Through the Use of Radiofrequency Identification Technology, Nov. 15, 2004, *available at* http://www.fda.gov/bbs/topics/news/2004/NEW01133.html) (using RFID to monitor and track containers of drugs). RFID chips have also been used recently to track the location of children on a school and city-wide basis. Tresa Baldas, *Little Chip Evokes Big Brother: High-Tech Tracking Brings Privacy Fears*, 10/04/2004 NAT'L L. J. 1 (Col. 1); Matt Richtel, *In Texas, 28,000 Students Test an Electronic Eye*, N.Y. TIMES, Nov. 17, 2004, http://www.nytimes.com/2004/11/17/technology/17tag.html?ex=1258434000en=50d708224le1c3bfei=5088partner=rssnyt.

being able to recognize the location and identity of physical objects.[212] RFID technology makes at least the object-side of that equation currently possible. Current RFID technology uses a 96-bit identification code, providing enough codes so that each object can have a unique identifier.[213] Similarly, IPv6 seems capable of providing a unique IP address to every object around the world.[214] While IPv6 is not a hardware technology, it would allow objects to take advantage of currently established Internet protocols as an information system—truly creating an "internet of things."

As another example, Global Positioning Systems ("GPS")[215] that are capable of continuously monitoring the location of an automobile or other object have moved from being an emerging technology to being quite common.[216] In addition to functioning with an internal mapping device intended for the benefit of the driver, GPS has already been used to provide information about the location of the automobile to another party. Recently, some Californian renters of automobiles

---

[212] For example, an Italian manufacturer has produced a model of a washing machine capable of reading care instructions off of an RFID embedded chip. Jonathan Weinberg, *RFID, Privacy, and Regulation, in* RFID APPLICATIONS, SECURITY, AND PRIVACY 83, 85 (Simson Garfinkel & Beth Rosenberg eds., 2006).

[213] Beth Givens, *Activists: Communicating with Consumers, Speaking Truth to Policy Makers, in* RFID, APPLICATIONS, SECURITY, AND PRIVACY, 431, 432 (Simson Garfinkel & Beth Rosenberg eds., 2006) ("The capacity of the Electronic Product Code (EPC) tags, currently at 96 bits, is sufficient to uniquely identify all objects around the globe.").

[214] Posting of Glyn Moody to Netcraft, Internator 3: Rise of the Devices, http://news.netcraft.com/archives/2004/03/19/internator_3_rise_of_the_devices.html (Mar. 19, 2004, 06:08 UTC). The current system of internet addressing is called IPv4. IPv6 is the designated successor to the current addressing system. The primary difference is that each address in IPv6 will be comprised of 128 bits. In contrast, the addresses in the current IPv4 system contain only 32 bits of information. This switch will allow for exponentially greater number of unique internet addresses. By increasing the address space from 32 to 128 bits, the number of IP addresses will increase to 665,570,793,348,866,943,898,599 per square meter of the Earth's surface. Robert M. Hinden, *IP Next Generation Overview*, 39 COMMN'S OF THE ACM 61 (1995), *available at* http://playground.sun.com/pub/ipng/html/INET-IPng-Paper.html.

[215] *See generally* Waseem Karim, Note, *The Privacy Implications of Personal Locators: Why You Should Think Twice Before Voluntarily Availing Yourself to GPS Monitoring*, 14 WASH. U. J.L. & POL'Y 485 (2004) (discussing the types of GPS-based personal locator devices currently available as well as the potential privacy-related pitfalls possibly resulting from their widespread use).

[216] *See generally* GPS World, http:// www.gpsworld.com/gpsworld/ (last visited Apr. 1, 2008).

discovered after returning their weekend rentals that their bill was in the thousands of dollars instead in the hundreds of dollars. It turned out, unbeknownst to them, that GPS in the rentals had monitored the vehicle crossing into another state and that the fine print in the rental contract provided for relatively high additional charges if the rental was taken out of California. [217] Other instances of such GPS monitoring of automobile use have been reported. Several automobile rental agencies have monitored the speeds at which cars are operated by the renter, and then imposed fines on renters who have exceeded speed limits.[218] Systems are being marketed to parents of teenage drivers that alert the parent whenever the automobile exceeds certain speeds or leaves certain proscribed areas and that allow the parent to access the automobile's location and driving history.[219] The fairly well-known LoJack system also communicates information on automobile location to third parties.[220]

In addition to location related information, physical characteristics of the automobiles are monitored by systems within the car and the collected data is then transmitted to another party upon the happening of some condition. For example, OnStar systems monitor automobiles and automatically contact a third party if an automobile accident is detected by the system.[221] Another example of information collection would be the "engine control unit" of the Lotus Elise sports car.[222] This component records data, such as the revolutions per minute, about the usage of the engine after the automobile is sold. The manufacturer claims the information is for

---

[217] GPS Keeping Tabs On Car Rentals, CBS EVENING NEWS, Mar. 6, 2004, *available at* http://www.cbsnews.com/stories/2004/03/06/eveningnews/main604461.shtml (television interview by John Blackstone with Ron Lee, in San Mateo, Cal.).

[218] Anita Ramasastry, *Tracking Every Move You Make: Can Car Rental Companies Use Technology to Monitor Our Driving?*, FINDLAW, Aug. 23, 2005, *available at* http://writ.news.findlaw.com/ramasastry/20050823.html.

[219] MicroTRAKgps, Secure Your World, http://www.microtrakgps.com/downloads/Auto_Brochure.pdf (last visited Apr. 1, 2008).

[220] LoJack Corp., What is a LoJack?, http://www.lojack.com/what/index.cfm (last visited Apr. 1, 2008).

[221] OnStar by GM., *OnStar Technology*, http://www.onstar.com/us_english/jsp/explore/onstar_basics/technology.jsp (last visited Apr. 1, 2008).

[222] Lars Smith, *RFID and Other Embedded Technologies: Who Owns the Data?*, 22 SANTA CLARA COMP. & HIGH TECH. L.J. 695 (2005-2006).

use by mechanics to help diagnose problems that may occur, but it has also been used to void a warranty because the data indicated that the owner had driven the automobile in a manner that constituted misuse.[223] General Motors' much advertised features of real-time diagnostics and of receiving e-mails from your car point to the currently existing ability to transfer collected information. It is not difficult to see how the same or similar systems could monitor an unlimited variety of data inputs, which could reveal exhaustive information about an automobile's use.

Another step toward control of an object by someone other than the possessor, and, thus, the first step towards interference with the exercise of personal property rights, is the "intelligently" responsive object or environment. Dynamic, automated response indicates that control of the operation or use of the object is no longer with the possessor. One example of currently available technology is Adaptive Cruise Control ("ACC").[224] The ACC feature senses slower vehicles ahead of the car, automatically slows the car to match speeds with the slower vehicles, and then speeds the car back up to the set speed once the slower vehicles are no longer in front of the car. No intervention on the part of the driver is necessary.[225]

In addition to these examples of monitoring and automation through technology, examples of the next step, technological control, have also started to appear. Automobile dealers can now equip the vehicles they sell with a device that allows the dealers to remotely disable the automobile's starter, an option the dealers exercise if the purchaser falls behind on his payments.[226] Additionally, OnStar systems now appear to provide a remote third party with the ability to unlock an automobile's doors.[227] These systems, demonstrating the

---

[223] *Id.*

[224] Guy H. Walker, Neville A. Stanton, & Mark S. Young, *Where is Computing Driving Cars?*, 13 INT'L J. HUMAN-COMPUTER INTERACTION 203, 203–29 (2001).

[225] *Id.*

[226] Sekurus, Inc., *How ON TIME Works*, http://www.sekurusontime.com/PRODUCTS/HOWONTIMEWORKS/tabid/58/Default.aspx (last visited on Apr. 1, 2008) ("The ON TIME system is a legal electronic payment protection unit that uses microprocessor-based technology to turn credit-challenged prospects into paying customers who pay in a timely manner. ON TIME will remind the vehicle operator when payments are due, and it will disable the vehicle if payments are not made.").

[227] OnStar by GM, *OnStar Services*. http://www.onstar.com/us_english/jsp/explore/onstar_basics/services.jsp (last visited Apr. 1, 2008).

technological ability to control aspects of an automobile's use remotely, are becoming commonly available as other commercially available systems have also begun to provide both the ability to disable starters and to lock and unlock doors remotely.[228]

While many of these examples may not show interference with traditional property rights—as the renters do not own the GPS tracked automobiles, the LoJack use is voluntary, and the title to the starter disabled automobiles may remain with the dealer until payments are completed—they do demonstrate the increasing ability of technology to monitor and control real world objects such as automobiles.

In addition to the evidence of emerging technology that allows monitoring and control, the producers of goods already show strong inclinations to incorporate such technological controls into their business models. Inkjet printer cartridges are an excellent example. The control in this case is currently maintained through technology and an arguable perversion of the anti-circumvention provisions of the Digital Millennium Copyright Act,[229] but even greater control could be provided by a remote network-driven authorization system. Current inkjet replacement cartridges contain technology that creates a basic communication between the cartridge and the printer.

The purpose of the communication is to prevent unauthorized cartridges, those made by a competitor, from functioning in the printers. This prevents competition in the market for replacement cartridges and in turn allows the original producer of the printer and cartridges to charge very high prices for the cartridges. This has developed into a business model in which the printers are sold at a relatively low price because the producer knows that it can reap its profit from the sale of highly priced cartridges. Similar technology could be used in other ways to increase the need for the producer's cartridges. Again, the cartridges could have an artificial pages-printed limit or an artificial expiration date, both of which could be enforced within this small trusted system of cartridge and printer.

Inkjet manufacturers have also used techniques based on internet connectivity to monitor usage of printers they have previously sold to customers, thus demonstrating the possibilities for ubiquitous computing environments in which objects regularly communicate with each other. The particular technique used might be more

---

[228] *See* MicroTRAKgps, *supra* note 219.

[229] John Leyden, *Lexmark Unleahes DMCA on Toner Cartridge Rival*, REGISTER, Jan. 10, 2003, http://www.theregister.co.uk/2003/01/10/lexmark_unleashes_dmca_on_toner/.

accurately described as spyware.[230] Lexmark has evidently used spyware in conjunction with their printer and printer software to secretly monitor tracking software that reported printer and cartridge usage back to Lexmark.[231] Other companies have also taken advantage of connectivity to control after-market use of products. Microsoft has recently linked its online gaming services for the popular game "Halo 2" with a system to monitor connected Xbox consoles for after-market modification by their purchasers. If the Xbox used to attempt to play Halo 2 on Xbox Live has been modified, the users have been banned from play on Xbox Live, making many of the most desirable features of Halo 2 unavailable to the users.[232]

Furthermore, industry practices within the inkjet industry also point to the desire and willingness to use contracts to control consumer use of objects such as printer cartridges. Currently, most packaging of inkjet cartridges contains statements such as "Licensed for single use only. Not intended for refill."[233] It is doubtful that such language constitutes a binding contract, as there is no indication of assent by the purchaser. However, it is not difficult to envision technology in a more networked world that would allow for the producer to obtain, as a condition of purchase or license, a binding click-wrap or shrink-wrap agreement.[234] The technology for monitoring and enforcing compliance with such a contract is also not difficult to envision.

The technological possibilities described may not be the ones that develop into use, and whether they are or are not is not the point of

---

[230] Dan Ilett, *Spyware Charges Levelled at Lexmark*, SILICON.COM, Nov. 12, 2004, http://www.silicon.com/research/specialreports/protectingid/0,3800002220,39125876,00.htm..

[231] *Id.* The cartridge, printer and internet-connected computer form, in effect, a mini-ubiquitous computing environment.

[232] David Becker, *Is Microsoft Using "Halo 2" to Thwart Xbox Hackers?*, CNET NEWS, Nov. 12, 2004, http://www.news.com/Is-Microsoft-using-Halo-2-to-thwart-Xbox-hackers/2100-1043_3-5449160.html.

[233] Michael J. Madison, *Rights in Things*, Remarks at First Annual Intellectual Property & Communications Law and Policy Scholars Roundtable, Michigan State Univ. DCL College of Law (Feb. 20, 2004) (transcript on file with author).

[234] As the ability to control objects in an efficient automated manner increases, the need for a contract decreases. The contract can still play a role as a means to prevent engineering around the monitoring and control, as well as a means to make the penalty to non-compliance higher than the value of continued possession and use of the object.

their description. The point of their inclusion is to demonstrate that such technology is possible, or even likely. What is more important is the impact of the technologies, whatever their exact form, on traditional personal property rights. The examples included are intended to persuade the reader of first the potential for emerging ubiquitous computing to interfere with the exercise of personal property rights and second the likelihood of some commercially viable technology developing that would impinge on traditional personal property rights, thereby raising the issues presented.

IV. QUESTIONS RAISED BY INTERFERENCE WITH PERSONAL PROPERTY RIGHTS

The interference with traditional personal property rights enabled by ubiquitous computing technology may have detrimental effects. Of course, the effect of technology might also be described as a change in possibilities that may present benefits as well as detriments. In order to assess the desirability of such changes, other questions must be answered.[235]

The obvious starting point is to ask what value the traditional property rights related to use, enjoyment, and alienation have, and whether that value is important enough to override freedom of contract. In deciding whether certain property rights are socially beneficial such that they may need to be maintained even in the face of contrary contracts, one of the traditional property rights whose value needs to be ascertained is the right of alienation. While the right of alienation is frequently cited as a longstanding right at the heart of property since the transition away from feudalism, and while restraints on alienation are also frequently described as being strongly disfavored,[236] there has been relatively little discussion of the value of the right of alienation. This is especially true with respect to the right of alienation as it applies to personal property.

---

[235] This paper focuses primarily on the technology-enabled reallocation of property rights between private entities, such as producers and consumers. However, similar technology-enabled changes in property rights of users of personal property could also take place between governments and the governed users. Ubiquitous computing technology presents myriads of new options for regulation. For example, speed limits could be enforced by directly preventing a vehicle from traveling faster than allowed speeds rather than relying on the pre-ubiquitous method of rare negative incentives in the form of speeding tickets. Presumably, the presence of government action would present additional policy issues and potentially constitutional issues.

[236] *See, e.g.*, Michael D. Kirby, Commentary, *Restraints on Alienation: Placing a 13th Century Doctrine in 21st Century Perspective*, 40 BAYLOR L. REV. 413 (1988).

Interference with or reduction in traditional rights of use and enjoyment should also be weighed. Rights related to use and enjoyment of personality have rarely been explored, probably because restricting a possessor's use of an object is difficult, as a practical matter, in a non-ubiquitous computing world. It may be that we have never before been forced to examine the extent, scope, and value of rights of use in personal property. One possible way to look at the detriment to the reduction in rights of use and enjoyment is to look at its effect on personal autonomy. The increased ability to monitor and control objects that have existed in private space and under private control might lead to, or be characterized as, a decrease in personal autonomy.

Early pundits have extolled the information society as increasing the ability of the individual to communicate and interact with a broader audience; in a sense the information society gives the individual a greater space, all of cyberspace, in which to act. However, the opposite effect may occur at the same time. Two cyberspace examples, in terms of the effect on an individual's ability to act, would be digital rights management and malware; both can decrease an individual's ability to act on the individual's own computer. The information society, as embodied by ubiquitous computing's increased ability to monitor and control, may also shrink the space in which individuals may act. By restricting use of personal property in what has previously been private space, the individual may be less free to act.

This is consistent with one of Weiser's original conceptions of ubiquitous computing. In a very simple drawing, Weiser illustrated the intertwining of an individual's space with the rest of the world brought on by the increasing computer mediation and interconnectivity achieved through ubiquitous computing. The drawing consisted of two frames, the first depicting the relationship between an individual and the rest of a pre-ubiquitous world and the second depicting the same relationship in a ubiquitous computing world.

The first frame of the drawing contained an individual's space, represented by a small closed shape, surrounded by the rest of the world, represented by the rest of the area in the frame. A few lines were drawn overlapping both the closed shape and the surrounding area. These showed that in a pre-ubiquitous world there was very limited ability for an individual to act beyond their space as well as very limited ability for the rest of the world to act in the individual's space. In the second frame, the same areas were used to represent the individual's space and the rest of the world, but instead of a few overlapping lines, a vastly greater number of lines overlapped both

spaces and pushed deeper into the shape representing the individual's space.[237] One effect illustrated by the drawing is the increased ability of those other than the individual to act in the individual's space. It could also be argued that the increased ability to remotely monitor and control physical objects within the individual's space could also be represented by shrinking the shape representing the individual's space.

Certainly, applying the normative personhood theory to property rights in this context would lead to a similar conclusion about the effect of ubiquitous computing on the individual. If the existence and the exercise of property rights are important to the realization of the individual, then a decrease in personal property rights would decrease that realization. The benefits of recognizing property rights, as stated by the normative justification provided by the personhood theory, would be directly blocked.

The advance of ubiquitous computing and its ability to enable interference with the use of an object may also force us to reexamine what possession means. Oliver Wendell Holmes provided us with a classic explanation of possession. "To gain possession, then, a man must stand in a certain physical relation to the object and to the rest of the world, and must have a certain intent . . . . The physical relation to others is simply a relation of manifested power coextensive with the intent."[238] In further describing the necessary physical relation, Holmes said "there must be a certain degree of power over the object."[239] The requisite intent for possession, in Holmes's account, was "an intent to exclude others."[240]

Ubiquitous computing would seem to impact both aspects of possession by taking the ability to control and the ability to exclude and separating them from the physical. Through ubiquitous computing technology, an object in the physical custody of one can be controlled and accessed by another who is physically distant from the object. When the ability to control and physical proximity become separated, when the ability to control can be balkanized, and when physical custody no longer includes the ability to exclude, both the legal meaning and application of possession may be altered.

---

[237] Ubiquitous Computing, *supra* note 3.

[238] OLIVER WENDELL HOLMES JR., THE COMMON LAW, LECTURE VI 216 (Little, Brown ed., 1945) (1881).

[239] *Id.*

[240] *Id.* at 220.

In addition to being framed as a choice between personal property rights traditionally held by a user and contract-defined rights agreed to by the provider and user, the issue can also be framed as a choice between public ordering and private ordering. Will we determine rights through publicly chosen sets of property rights or will we leave the rights to be determined individually between private parties? Here, existing analysis debating the relative merits of public versus private ordering may provide a starting point for evaluating the potential impact of ubiquitous computing on personal property rights.

Ubiquitous computing technology may add a wrinkle to the debate over private versus public ordering. A legal realist would generally point out that you can never have pure private ordering because, absent voluntary compliance, private ordering will always have to rely on the state for enforcement.[241] This is particularly true for private ordering through contract. While private parties may order rights between themselves through contract, enforcement of those rights can be achieved only by calling upon the power of the state, and when the power of the state is invoked, some degree of public ordering can enter the arrangement.[242] Ubiquitous computing technology, however, may drastically reduce reliance on the government for enforcement of private ordering.[243] Therefore, potential differences between contractually-enforced private ordering and technologically-enforced private ordering may need to be taken into account. Because of the reduced or eliminated reliance on the government for enforcement, technologically-enforced private ordering[244] may need to be evaluated as a different type of private ordering distinct from contractually-enforced private ordering or as a different type of ordering distinct from both public ordering and private ordering.

Examining the problem from this perspective may also allow for the benefits of private ordering to enter into the equation. These benefits might be characterized as those flowing from the freedom of contract or as flowing from the operation of the market. One example might be the ability to practice effective price discrimination. Price

---

[241] *See generally* Yochai Benkler, *An Unhurried View of Private Ordering in Information Transactions*, 53 VAND. L. REV. 2063 (2000).

[242] The Doctrine of Unconscionability is one example.

[243] *See generally* LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE (Basic Books ed., 2000).

[244] I often refer to this type of ordering as "Technological Ordering" in order to distinguish it from other types of ordering.

discrimination is not possible when a low price purchaser can resell the item and undercut the original producer. If ubiquitous technology can prevent resale, then the ability to practice effective price discrimination between users who place different values on the object is increased and greater welfare is created. Another way of examining these possibilities is to consider that these technologies could make it possible for an individual to pay only for the uses desired rather than having to pay for all possible uses or for having to pay for ownership when only use for a limited time is desired.[245] In other words, the pre-ubiquitous practical reality that all use of, and control over, a physical object passed to the possessor may be a market inefficiency, one that may be solved by ubiquitous computing technology.

In addition to examining the potential benefits of increased private ordering, potential negative consequences flowing from increased private ordering and the loss of potential benefits derived from public ordering should also be considered. One way to examine such possibilities is to look at the role public ordering currently plays in this area and consider whether the need for such a role is affected by ubiquitous computing technology. For example, the potential for, and impact of, legislation as publicly ordered overrides technologically-enforced private ordering should be addressed. Any potential impact of the law of Sales and the Uniform Commercial Code, as enacted, may need to be examined. What effect do the presumptions in favor of title passing to a purchaser have, and how easily can such presumptions be overcome in a ubiquitous computing environment? What benefits are derived from or what detriments are avoided by such a presumption? Additionally, consumer protection legislation may provide an area of inquiry. At least one example of a legislative response, taking the form of consumer protection legislation, has already been seen.[246]

---

[245] Some environmentalists even see this possibility as a means for lowering carbon footprints. This concept, called "Locality", basically involves a substantial number of individuals sharing seldom used objects rather than each individual purchasing their own object. Because fewer objects have to be produced, each individual's carbon footprint is smaller. The ability to track and locate individual objects, made possible by ubiquitous computing, makes the sharing arrangement much more practical. *See, e.g.*, Forum for the Future, *Low Carbon Living 2002*, Sept. 24, 2007, http://www.forumforthefuture.org.uk/lowcarbonliving2022.

[246] *See, e.g.*, Ramasastry, *supra* note 212 (describing how several states have, through legislation styled as consumer protection, prohibited the use of GPS data to track the speed and locations of rented automobiles for certain purposes).

Another possible place to look for answers, which may in large degree overlap with the choice between public ordering and private ordering, is to examine the reasons for the development of a limited set of property estates. What value does the principle of *numerus clausus*, to borrow the civil law term, have? Both common law and civil law have evolved property systems that have a small number of possible estates, a limited number of possible combinations of property rights. Individualized variations, often termed "fancies," have been strongly disfavored. [247] In other words, these attempts at private ordering have been restricted in favor of the publicly ordered system of limited estates.

One suggestion is that having a limited number of possible bundles of property rights beneficially reduces information costs.[248] The effort a possessor or potential purchaser of an object has to exert in order to determine the rights acquired is an additional cost. That cost is lowered if only a few predetermined bundles of rights are possible; in contrast, if each bundle of rights can be different, information costs are increased. Thus, if ubiquitous computing technology makes it possible for the bundle of rights associated with each individual object to be customizable into infinite variations or fancies, information costs may increase. Of course, the same ubiquitous computing technology that would make such fancies possible is at its heart information technology, and, thus, that same technology might also lower information costs. While a 'virtualized' object might come with a number of restrictions such that the possessor's bundle of rights might be termed a fancy, the object itself might be able to describe that bundle in perfect detail with near-zero search costs for the possessor or potential purchaser.[249]

Another useful avenue of inquiry may be to examine other existing legal arrangements that are hybrids of contract and property law: for example, bailment and leases. Both bailment and leases are rights ordering systems that are hybrids of contract and property; in these systems, a possessor's rights in a particular piece of property are no longer determined by property law alone, but rather by property law

---

[247] Thomas W. Merrill & Henry E. Smith, *Optimal Standardization in the Law of Property: The* Numerus Clausus *Principle*, 110 YALE L.J. 1, 24–42 (2000–2001).

[248] *Id.*

[249] Authentication costs as a type of information costs might be harder to lower in a digital information environment than search costs.

mixed with contract.[250] As such, attempting to extrapolate from existing experience and knowledge with bailment and leases to a potential state of affairs where virtually all initial transfers of physical objects are governed by either the law of bailment or by leases may provide useful insight.

V. CONCLUSION

The emergence of ubiquitous computing technology will make it possible for the producer of an object to interfere with a user's exercise of traditional personal property rights; instead, a private ordering system based on technological control and contract will be imposed.

The technological changes hypothesized by the ubiquitous computing literature may or may not come to pass,[251] but given the possibility or even probability that the advances will take place, it is important to begin consciously thinking about the desirability of such changes and how they might be dealt with legally.

> The trouble is that in the present situation, time and useful insight are both in short supply. While we have a window of time left in which to consider the manifold challenges of [ubiquitous computing], and to articulate a meaningful response to them, that window is closing. Ubiquitous computing appears in more places, in more guises, and in more ambitious conceptions with every passing day, and we've barely begun to confront it in the depth of understanding it demands.[252]

Because technology has not yet forced the question on us with respect to real world personal property, asking the same question in the context of virtual world objects may be beneficial. How will we view the contracts and the rights management technology that alter

---

[250] Thomas W. Merrill & Henry E. Smith, *The Property/Contract Interface*, 101 COLUM. L. REV. 773, 819–21 (2001).

[251] Sustainability of current and future energy usages, for example, may prevent a barrier to ubiquitous computing. *See* GREENFIELD, *supra* note 1, at 6 ("Every argument in this book [about ubiquitous computing] is, at root, predicated on the continuing existence and vitality of our highly energy-intensive technological civilization. This book should not be construed as a statement of belief that our current way of life is in fact sustainable.").

[252] GREENFIELD, *supra* note 1, at 260–61.

traditional personal property rights? This question, now before us in the context of virtual world objects, is the same question that may soon be before us in the context of real world objects. Thus, how we answer the question for ownership of virtual world objects may have important consequences for real world property ownership in the future.[253] At the least, examining the virtual world object ownership question and the consequences of the answer may inform future discussion of similar issues in the arena of real world personal property. At the same time, as we address the debate in virtual worlds, we may want to keep the possibilities for real world property in mind.

[253] The possibility that the issues surrounding virtual world objects will be mirrored by future issues surrounding real world property has occurred to at least one other legal commentator. Posting of Michael Froomkin, to Discourse.net, http://www.discourse.net/archives/2003/11/virtual_worlds_a_dystopian_thought_intrudes.html, (Nov. 14, 2003, 10:43 EST).